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DYNAMO VARIATIONS.

At one time the number of types of dynamo either made and put on the market for sale—or, at least, suggested and advocated—was pretty considerable, but ultimately the disposition amongst makers was seen to be in favour of two or three simple types, which were found by experience to be best. Types possessing "peculiarities" have been gradually weeded out. The process is not yet complete, but everything is in favour of simplicity, and it is only in special cases where some strong necessity exists for it that the unusual will be retained. Take, as an example, the Brush and Thomson-Houston dynamos. For their own special high-tension series arc lighting work they are practically in undisputed possession of the field; but we believe that for ordinary low-tension purposes the Brush Corporation never employs anything but Victoria dynamos; while even in America the field found for low-tension Brush machines is not a very extensive one. Similarly, the attempt to use Thomson-Houston machines for ordinary incandescence lighting could not but result in failure. In such work the special qualities of the machine are not of any value. We notice, nevertheless, at the Italian Exhibition a machine of small size for about a hundred volts, having the same external form as the arc lighting dynamos, but with the globular armature wound with a simple drum winding of about 50 sections, and having a commutator of ordinary construction. It must be evident to anyone familiar with the subject that a machine of similar output could be constructed much more cheaply on ordinary lines, and we believe this view has been recognised by Prof. Thomson himself, who has recently designed a low-tension dynamo very similar to one of the ordinary forms of such machines.

Again, armatures of the Gramme and Alteneck type have gradually lost the "Pacinotti projections" which once had many advocates, and have enjoyed in their simple form an almost uninterrupted period of favour, the only exception to which has been a return to the Pacinotti teeth with a thin external layer of iron, which, as it were, connected the teeth outside the winding, so as to entirely cover it and reduce the air gap to what sufficed for simple mechanical clearance. This form, originally introduced or proposed by Wenstrom, a Swedish electrician, was used pretty extensively by the Oerlikon firm, and has quite recently had attention drawn to it, with some modifications, by Mr. Swinburne and Mr. Crompton. This method of reducing the magnetic resistance probably is more trouble in carrying into practice than it is worth. What is the main advantage of reducing the magnetic resistance? The main advantage is a lessening of the copper and energy required for excitation. No increase in the output of the armature is obtained. This should be borne in mind. Pacinotti projections, whether in their simple form, or with the outer envelope of iron, do not in all cases have the effect of diminishing the magnetic resistance. A certain amount of space is required for the conductor on an armature, and that space is the same whether Pacinotti projections are used or not. It is a mistake to suppose that less winding will suffice for toothed armatures than for plain ones. The amount of winding in a given armature depends upon the magnetic density of the armature core, and taking it that the same density is sought to be attained whether the core is toothed or smooth, it will be seen that the only difference will be that in one case the conductor must be disposed in a number of deep pockets, and in the other case it will be spread over the whole armature in a thin and even layer.

Then the magnetic resistance between armature core and field poles is in the case of smooth cores a certain definite air space, while in the case of toothed cores it is less simple, being made up as regards air of a small air space between the teeth and the polar face and a much longer air path between the armature core proper (that is, the mass of iron within the winding) and the polar face. The magnetic resistance of the projections is rather a misleading quantity. Until examined, it at first sight appears that these projections must do a good deal to reduce the resistance, but as a matter of fact, they do little or nothing. The armature core is worked now-a-days at a magnetic density approaching saturation. The teeth or projections or the portions of them concerned in carrying lines of force cannot be made to have a combined cross section of more than a comparatively small fraction of the core, and they are therefore in such a highly saturated condition that their magnetic resistance approximates to that of air. Thus it will be seen, that even as a means of diminishing the magnetic resistance, and therefore the amount of copper and energy in the fields, the employment of projections does not offer nearly so great an advantage as has often been supposed. And this applies to both the forms alluded to, viz., the simple toothed form, and the form with externally connected teeth. In the latter, the thin external shell may act as a conductor to convey lines of force to the teeth, but as these latter are saturated, it probably transmits the lines on to the core through the air gaps in which the winding is placed, and does no more good than could be achieved by making the clearance between the winding and the polar face the same as it is between the exterior of the iron shell and this face.

Under all the circumstances, we think those who have continued to use simple smooth cores have probably acted wisely, and this opinion is rather supported by the description of the latest Oerlikon dynamo, which consists, so far as the armature is concerned, of the simple Gramme construction, having a single layer of conductor about a quarter of an inch thick, spread uniformly over the surface. The machine is a large one, and as in large machines the peculiar construction hitherto adopted at Oerlikon is most readily carried out, we think we may safely infer that the absence from this latest machine of the peculiarity is a proof that its advantages were not great.

But this machine, although containing no novelty except a return to ordinary practice on the part of the designer of the armature, possesses one or two features worthy of a passing observation. The armature is a simple Gramme ring, the field is four-poled and consists entirely of cast iron. Are we to assume from this that the tide which set so strongly in favour of simple two-pole machines with drum armatures and wrought iron field is becoming slower or even that it has turned? We think we may make this assumption, and may quote in further support of it the very significant fact that the Berlin branch of the firm which originally introduced drum armatures is now introducing a form of multipolar ring armature machine. These facts do not necessarily mean that the drum armature and wrought iron field as usually made are theoretically inferior to the ring with cast iron fields, but simply that the drum is more difficult to wind, insulate, and connect up neatly and safely than is the ring; and that the extra cost of labour, and the difficulty of getting suitable forgings at short notice, more than counterbalance the extra weight of metal and the rather greater amount of copper on the fields. We have long been of opinion that too much virtue was ascribed to "best Swedish soft charcoal iron," and we have been glad to notice that for the last year or so there has set in a reaction against its exclusive use. We do not for one moment mean to question the known magnetic properties of the materials, but in dynamo manufacture the balance of advantages is not always in favour of what may at first sight appear best.

MR. GEORGE KENNAN, the American writer whose articles in the *Century Magazine* are exposing in vivid colours the horrors of Russia's system in Siberia, was in early life intimately associated with telegraphy by birth and by occupation. His mother was related to S. F. B. Morse, the famous electrician, and he himself became a telegraphist at the age of twelve. When the Civil War broke out, he strove to procure an appointment as telegraph operator in the field, but he did not succeed. He then pressed General Anson Stager, Superintendent of the Western Union Telegraph Company, to put him on the expedition being organised to establish a telegraphic system through British Columbia and Alaska, across Behring's Straits and through Siberia, this scheme being projected as an alternative to the first Atlantic Cable, which had failed. In this he was successful, and, while only twenty years of age, he started for Eastern Asia on July 3rd, 1865, with the other members of the party. Young as he was, he had already distinguished himself as an electrician, and during two years' work in Siberia he rendered valuable service on the expedition and increased his own reputation. The completion of the second Atlantic Cable, however, put an end to this overland project, and after waiting a year in St. Petersburg, hoping the scheme might be revived, he retired to America, and subsequently drifted into journalism and authorship. During his travels he went through many hardships and strange adventures, and the story he is now telling in the *Century* is the result of a special journey he undertook in 1885 to investigate the treatment meted out by the Russian Government to the unhappy exiles in Siberia.

The Organising Committee of the London Chamber of Commerce met on Tuesday at Botolph House, Eastcheap. There being no other members of the Press present, we do not feel justified in publishing what transpired, beyond saying that five sub-sections were agreed upon, and that a council of 33 was suggested to represent in certain proportions the various sub-sections. Since the last meeting a large number of firms and individuals have joined the Chamber, the total number now amounting to about 150. As the date of the general meeting, originally intended to take place about the 15th of September, is considered a very inopportune time owing to many gentlemen probably being away from town, it was suggested that the second week in October would be preferable; but members will be in due course informed as to the decisions of the committee respecting the election of chairman, vice-chairman, and council. We feel assured that the electrical section of the London Chamber of Commerce is well on its way towards complete success, for it is now warmly supported on all sides.

HERE is a useful purpose for the phonograph at last. What an enormous quantity of foolish "gush" has been poured out over this instrument latterly, to be sure! But here is a suggestion that many a playgoer will commend. It is that leading actors and actresses should use phonographs in order to perfect themselves in their elocution. They would talk their parts into the machine, and then hear themselves recite, observing where they have failed to express the desired emotion, and where they have succeeded in touching the springs of tears or laughter. It is even said that some earnest players in America have already installed the phonograph as their guide, philosopher and friend. It was time they did something to hear themselves as others hear them!

A GREAT deal has been said and written latterly about the dangers of alternating currents. For a change we have now a story to tell of a man's life being in all probability saved by wires conveying high alternating currents. A Pittsville workman a little while ago fell from the roof of a house, and was only saved from being dashed to pieces by falling on some electric light wires which were conveying an alternating current of 1,000 volts; this current, in the graphic words of the newspaper reporter, "effectually prevented him from leaving go until some one came with a long ladder and helped him down."

"YOU see the earth was originally composed of electricity, with a mica shell about a quarter of a mile thick." *Do* you see it? We don't! and before we believe it we want to have one or two questions answered. First, what kind of a body was the earth in those days? Was electricity a visible entity then? and, moreover, who was there to see it? Then, what would have happened had anyone dug through that quarter of a mile of mica? Would the electricity have escaped, and the whole bubble burst? But wait—we are taking this thing seriously, and before we know who it is that startles us with this strange intelligence. Ah! only a preacher—an American preacher. Then it doesn't matter. But we may as well finish the extract before us from the "sermon" of Mr. C. W. Dean, "who speaks once each week at the Church of Nature in Chicago." "Mica," he says, "is condensed electricity. By making the earth in the shape of an egg and then causing it to revolve it turns the electricity over in the middle and makes two pulsations a day. You wouldn't suspect it, but these pulsations are very necessary, and but for them the earth would balk and stagger." No, Mr. Dean, we shouldn't have suspected it.

OUR New York namesake states that the system of incandescent electric lighting devised by Mr. Chas. Heisler, of St. Louis, is the only single wire incandescent method in the world. Evidently our contemporary has never heard of a gentleman named Bernstein. Furthermore we read that the loss of current over distance is small, and herein lies the value of the system, the reasoning given to show this being very funny. The wire resistance, says the American writer, *is small from the fact that any kind of wire can be used for the current.* The accommodating nature of the Heisler circuits is more than even a mathematical mind can grasp, so we will leave the solution of this enigma to Mr. Bernstein, if he can spare the time to undertake such an arduous task.

AS if this were not enough to make one feel that mental aberration was beginning to make itself apparent, we have to still further puzzle our overwrought brain in the attempt to solve the following:—"In operating the Heisler dynamo a speed of 150 to 180 revolutions is fast enough, as the dynamo is never run at a higher speed than from 600 to 800 revolutions." We resolutely refuse to proceed any further with the perusal of the lucid description of the Heisler system, for we fear that we might no longer be responsible for our actions.

A MUCH esteemed contemporary appeared to us to be somewhat inconsistent last week. After mildly upbraiding us for an onslaught upon a now immortalised specification, it adopted our own policy and followed in our footsteps. We fail to see, however, why it should have been thought to be incumbent upon us to publish the whole specification to enable readers to estimate its manifold absurdities, so we only culled those excerpts which seemed to us to demand special treatment. *Our* space is too valuable to be given up to the publication of a contract which all who wished to tender for were already in possession of.

NOT long ago we published a letter from a Mr. Sharman, who challenged the veracity of some information which we laid before our readers respecting the formation of that famous body the British Association of Medical Electricians. The following week we were enabled to entirely verify the truth of our statements, and we requested our correspondent to explain his conduct, but, as in such undertakings as those with which he is connected discretion is the better part of valour, he wisely refrained from rushing still deeper into a slough from which it would have been difficult to extricate himself. This week, however, he has favoured us with what he no doubt considers a glaring exposure of the position of several of our correspondents who have been most active in supplying information as to the transactions of Harness & Co. We fail to see what there is to discredit those gentlemen in the fact that one is in the telegraph service, another a late *employé* of Harness (his connection with whom he has himself already fully explained in the REVIEW), and a third engaged in the application of electricity for curative purposes. As the connection between Mr. Sharman and the President of the B. A. of Medical Electricians, whom he so warmly champions, and whose dignified silence in the face of the many hostile comments which have been made upon his medico-galvanic apparatus he enthusiastically extols, is well known, no good purpose would be served by giving them both a free advertisement in our columns. The young man who edits the *English Home* darkly hints that those who have been mixed up in what he terms a conspiracy against Harness will no doubt, ere long, receive the punishment they deserve. Mr. Sharman is very ill advised in telling us what is in store, for doubtless the guilty conspirators will now be more than ever on their guard, whereas had he maintained the same dignified silence as his Principal, the wicked men who refuse to recognise the *bonâ fides* of that great humanitarian might have been caught napping.

FOLLOWING this came a letter from a gentleman who signs himself "W. Fletcher Parkes, Cannock." He requests us to give him some information concerning an electric article about the size of a five shilling piece to hang on the chest and which is warranted to cure rheumatism, &c. The article in our last issue ought to meet the requirements of our correspondent, but curiously enough he requests us to send him a copy of our next. It will be remembered that in our "Eye-opener" last week a namesake of Mr. Parkes was mentioned, and it seems to us that there is more in this communication than meets the eye.

WE have in our possession several circulars drawing attention to Parkes's patent compound magnets which are said to be entirely different from any hitherto made, the power being distributed over an extended surface instead of concentrated in two points. The wearing of them we are assured unfailingly supplies nerve tone and blood ozonation by the penetrating influence of natural electricity. We presume that the magnet which is illustrated in our "Notes" column is a specimen. We have also had our attention drawn to "Parkes's magnetic pearls, for internal use, which are prepared by a new process from the natural oxide of iron in which the electric virtue of the oxide is retained. They infuse the blood with natural electricity and greatly assist the outward application of the patent magnets." It will really soon become necessary that human beings, following the example of some dynamos, should be made ironclad, so many magnetic appliances are there now ready to pounce upon the helpless individual who happens to come within their lines of force.

A SYNTHETIC STUDY OF DYNAMO MACHINES.

(*Continued from page* 146.)

I.—INDUCTION—(*continued.*)

6. *Work done in moving the coil.*—We have seen that the movement of the coil, C, from A creates an E.M.F. in the former which causes a current to flow in the direction of the arrow, fig. 15. The quantity of electricity for a given movement will depend primarily upon the resistance of the circuit through which it flows, and neglecting a secondary phenomenon which we shall consider in a future article, we may assume that the current at any moment is the E.M.F. divided by the resistance, or equal simply to $\frac{E}{R}$. The rate at which electrical work is being done at any moment is the product of E.M.F. and current, or E C, the mean rate into the time in seconds, giving the work done in Joules during the movement. In moving the coil a quantity of mechanical work has been expended, and an inexorable law of nature demands that the work done by the current shall be exactly equal to the work done upon the coil during the movement. A certain resistance to motion has been experienced from the fact that an electric current has been produced, and it follows as a direct consequence of the conservation of energy that the induced current flows in all cases in a direction such as to oppose the motion. It may seem unnecessary in these days to announce thus seriously a fact made apparent in the working of every dynamo machine; but, at all events, its enunciation by Lenz, when electrical science was yet in its childhood, constituted a very important advance. Observe that in fig. 15 the current induced in C, by moving from A, is in the same direction as the current in A, or, in other words, the currents in the two coils flow in directions parallel to each other. Now, since the current in C is such as to oppose the motion, it follows as a direct inference that *conductors in which currents flow in the same direction attract each other.* If C is moved towards A, the current in the former is reversed; but, since its flow again opposes the motion, it follows that *conductors in which currents flow in opposite directions repel each other.*

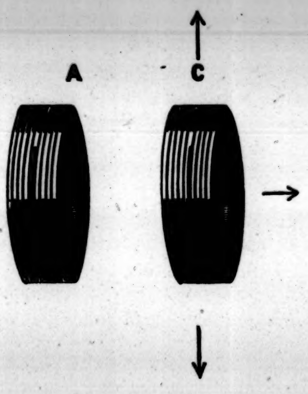

FIG. 15.

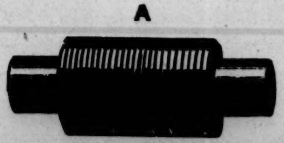

FIG. 16.

7. *Theories of Magnetism.*—The current in coil A, fig. 16, magnetises the piece of soft iron round which it flows, the ends protruding beyond the coil manifesting as marked a polarity similar to that which would be manifested by the coil faces through which they respectively protrude. We have mentioned that the N pole of a magnet produces an effect like that which would be produced by the face of a coil in which the current flows in an opposite direction to the hands of a watch, while the S pole produces an effect similar to that which would be produced by a current flowing in the opposite direction. We may therefore consider the magnets as current-carrying coils, and given two magnets placed with their N and S poles facing, as in fig. 17, it will be observed that the directions of the supposed currents are parallel to each other. There will result in consequence mutual attraction between the N and S poles, as mentioned in paragraph 4. Between similar poles there will be repulsion, since the imaginary currents flow in opposite directions, fig. 18.

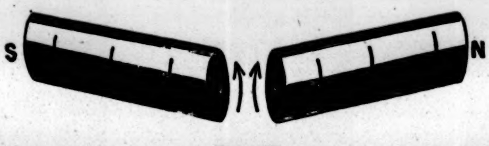

FIG. 17.

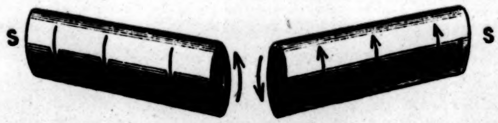

FIG. 18.

A knowledge of the above facts led Ampère to the enunciation of his theory of magnetism, which states that magnetism consists in the existence of electric currents circulating round the molecules of magnetic bodies. According to this theory, in iron or steel unmagnetised the currents round the molecules have relatively to each other no definite direction, magnetisation being the resolution to one common direction of the currents in all the molecules. Fig. 19 illustrates the theory by showing the N pole of a magnet, *a*, *b*, *c*, and *d* being molecules with their currents flowing in the directions shown. It will be observed that since the adjacent currents flowing in the separate molecules are in opposite directions the effect in the interior of the magnet is *nil*, and the result due to the currents in all the particles is the same as if there were circulating round the exterior of the magnet currents as in fig. 20. This theory is of little importance, nor has it any practical bearing on the subject in hand, though its conception arises out of the facts we have been considering. When we say that a magnet pole behaves *as if* it were the face of a current-carrying coil we utter a fact, but when we stray beyond this and invest each molecule with an actual current of electricity we are prone to become unscientific, if not absurd. It is always important to remember facts, though it is often dangerous to espouse the theory which pretends to explain them.

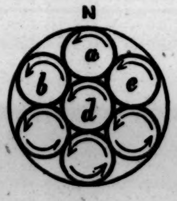

FIG. 19.

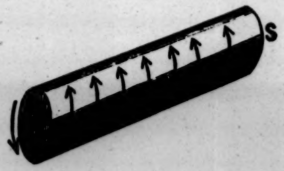

FIG. 20.

The theory of magnetism advanced by Professor Hughes invests every molecule of iron or steel with polarity, each being in fact a little magnet. An unmagnetised bar has its molecules with their poles lying in all directions, and magnetism is, according to this authority, a rearrangement of the molecules, whereby they are all constrained to turn their similar poles in the same direction. When the molecules are lying thus, they form a chain of small magnets with their adjacent poles, N and S, the continuity of the chain, or in other words, the degree of saturation in the iron or steel being greater as the constraint is increased. Absolute continuity or a chain of molecules with their magnetic axes lying strictly in line would mean absolute saturation; but it is unlikely that this can ever be attained, all experiments lending weight to the supposition that absolute saturation would require infinite constraint or necessitate infinite exciting power. According to Hughes's theory, magnetism is an inherent property of the molecules of magnetic substances, and the material is easy or difficult to magnetise accordingly as its molecules are capable or incapable of being readily induced to take up the position of magnetisation. In a bar of soft iron the molecules are easily rotated into the required position by an electric current sent round the bar, and for the time being the iron is strongly magnetic. But on the current ceasing the molecules resume their former positions. It is as if they had been under what might be called magnetic stress, and having been relieved from the constraint to which they had been subjected by the current, they immediately recover their normal attitudes. In a bar of magnet steel the behaviour is somewhat different. If such a bar is made glass hard and magnetised by a current sent round it, we shall find that the magnetism which can be induced in it is much less than in a soft iron bar having the similar dimensions; but on the other hand, when the current has ceased to flow, the bar will remain to a certain extent permanently magnetised. The difference in the behaviour of the two materials must be due to a physical difference in their composition and structure. We might say that the structure of the steel is such that the molecules can only be turned through a comparatively small angle by the utmost exciting power. This would explain the difference observed in the degree of magnetism. We might say also that due to the same peculiarity of structure the molecules experienced a difficulty in regaining their previous positions. This would explain the existence of permanent magnetism. While soft iron, from its structure, offers little resistance to the arrangement of its molecules, which we designate magnetism, it offers little resistance to their disarrangement when the exciting current is removed. Steel, on the other hand, offers a comparatively great resistance to the molecular arrangement, and its structure prevents to a certain extent disarrangement, acting like a restraining force when the external constraint due to an exciting current is removed.

Whether we accept or not in its completeness this theory of Hughes, it is certain that the true explanation of magnetism is to be found in the nature of the molecules composing magnetic bodies. If we take a thin magnetised blade of steel and break it in two, we get a pair of magnets each manifesting as when unbroken, N and S polarity. Again break one of the pieces; still we have in each a complete magnet. Carry on the process physically, and when from the nature of things this fails, let the subdivision be continued in the imagination until the molecule is reached. The magnetised bar is but a multitude of molecules, and the character of an aggregate is determined by the character of its units. It is in the nature of the molecule that we must seek for enlightenment, and the inference that in the latter we should likewise find a polarity manifested is irresistible. Is this ultimate polarity inherent or induced? We cannot tell, for we are unable to investigate the magnetic properties of a substance until its magnetisation is a fact. Nor do we know why a current of electricity produces magnetism at all. That the current and the magnetism are related as cause and effect, we know. We can correlate their respective magnitudes, but when we have done this we have reached the limits of knowledge. We are then face to face with ultimate scientific truths, with facts bound eternally by links ever invisible to the wisest among us.

(*To be continued.*)

REPORT OF EXPERIMENTS SHOWING THE EFFECT OF CONTINUOUS AND ALTERNATING CURRENTS ON LIVING ANIMALS.*

THE effects of electricity upon the human body have been a matter of deep interest and study to the medical profession from time immemorial, more particularly in earlier days, in its powerful form of lightning, and during the present century as a remedial agent.

On the persons of human beings lightning often strips off, tears or burns clothing, oxydises or melts buttons and watch chains, and renders knives magnetic. It may burn the skin and hair, lacerate and perforate the body, fracture bones (Taylor), cause extravasations of blood anywhere in the body, such as apoplexies of the brain or meningeal hemorrhages, amputate a limb (Sycanko, Berl, Klin, Woch, 1868), or cover the body with curious hyperaemic arborescent marks. Some die from the injuries received only after the lapse of considerable periods of time, as from tetanus (Taylor), or hemiplegia in a month (Bugge).

Of perhaps a third struck by lightning who live, most are subject to nervous diseases in various forms. They may be unconscious for hours or days, become delirious, even maniacal, have all sorts of paralysis and losses of sensation, be affected with blindness or deafness, or have convulsions, epilepsy or neuralgia. Heusner relates how a thunderbolt struck 20 people, killed four, burned or lacerated the clothing and skin of the rest, and in many made peculiar openings in the soles of the feet as it passed through their bodies into the ground.

The changes to be found on making a *post mortem* examination are almost wholly coarse lesions visible to the naked eye, such as laceration of the brain or other organs. *Rigor mortis* is said to appear early (Goguel), and often there is a cataleptic *rigor mortis* at the moment of being struck (Woodman and Tidy, "Handbook of Forensic Medicine"), so that persons are found dead in precisely the attitudes last assumed when living. The blood is dark and unusually fluid.

Of course, the number of volts of E.M.F. in a stroke of lightning is enormous, probably beyond our ascertaining.

Lightning may be imitated by means of frictional electric machines and discharges from Leyden jars. Two men have experimented upon lower animals with this artificial lightning.

In 1869 Dr. B. Richardson (*Medical Times*, 1869) used the gigantic induction apparatus of the Polytechnic Institute in London (weight 15 cwt., length of primary coil 3,770 yards, of secondary coil 150 miles and 41 Bunsen elements). With discharges from this machine and Leyden jars he killed sheep and rabbits. *Post mortem* examinations were then made by Dr. Sedgwick. The blood vessels of the brain were often found distended, the heart gorged on the right side, healthy on the left, the intestines intensely congested and the blood black and fluid. At the same time he passed a shock through bright red blood in a test tube, turning it immediately black, then reddening it again in a jar of oxygen, and again repeating the experiment, thus proving a chemical effect of the electric shock on the blood.

In 1880 Professor Nothnagel of Jena ("Virchow's Archiv.," vol. lxx.), experimented on a rabbit with discharges from Leyden jars with an ordinary frictional electric apparatus. He did not kill the animal, but produced anæsthesias and paralysis, which lasted generally but a few hours, and concluded that it is seldom that lightning injures nerves permanently, that animals are either killed at once or recover from the effects of the stroke.

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* Read by Dr. Frederick Peterson before a meeting at the School of Mines, Columbia College, New York, July 30th, 1888.

In medicine our most important electric remedy is the continuous current. The continuous current of a battery may be made to alternate by means of a commutator, producing shocks known as "voltaic alternatives," in other words, alternations of current.

In studying the physiological effects of the continuous current upon living nerves it is found that the action of the positive differs from the negative pole. The irritability of the nerves is peculiarly altered by each. The phenomena produced are designated anelectrotonus. The excitability of the nerves is diminished in the neighbourhood of the positive pole or anode and increased in the neighbourhood of the negative pole or cathode. These states are respectively termed anelectrotonus and catelectrotonus. Whenever the continuous current is made or broken a contraction of the muscles supplied by the nerves takes place, the closure contraction at the cathode being strongest. It is evident, therefore, that if a continuous current passing through the body be suddenly reversed or alternated, and travel in the other direction, that there is also a reversal of the effects of the two poles. So that the diminished irritability at the anode not only goes back suddenly to normal but passes that and becomes the increased irritability of the cathode. Hence an alternation of the direction of the current is twice as powerful, its shock twice as great, as that of a mere interruption of the current. To the truth of these statements every physician familiar with electricity and every book on electrical therapeutics and electro-physiology will bear witness.

In medical practice we use batteries of comparatively small voltage, generally from 10 to 100 volts, and in treatment we encounter resistance in the human body. The skin is the chief obstacle to the passage of the current, the resistance of the intermediate saline fluids and tissues being almost negligible. "2,500 ohms may be assumed to represent the average resistance of the human body in the usual medical application. (De Watteville.) Consequently physicians do not measure current strength by the ampère, but by the $\frac{1}{1000}$th of an ampère, or milliampère. We rarely use even 30 milliampères current strength in the treatment of nervous diseases, but sometimes 200 to 500 for the electrolysis of tumours. But even with the mildest currents, scarcely felt when passing continuously through the body, and not much felt when the current is simply made or broken, an alternation may produce considerable pain. Indeed, such an alternation, if passed through the head will cause giddiness and nausea. De Watteville, our best authority, says in his book on "Medical Electricity," "Voltaic alternatives, as such current reversals are called, are indicated where a still more stimulating application than interruptions is required, and a corresponding degree of caution must be exercised in their use."

I am willing to demonstrate on anyone here present that alternating current shocks are more powerful and severe than a continuous current on its mere interruption. As a current will stimulate a nerve in something like $\frac{15}{1000}$th of a second, it is clear that when the continuous current is closed upon a body for any limited space of time, there is but one shock at the closing, and one at the opening of the circuit; whereas with an alternating current for the same interval of time, the shocks are twice as strong, and as many in number as there are reversals of the current per second. If the stimuli are too numerous, say over 65 per second, a condition of tetanus is produced in the muscles supplied by the nerves stimulated. The same fact holds good as to currents of any strength. From this it must appear plain that if a continuous current, say of 1,600 volts E.M.F. is sufficient to cause death, then an alternating current of much less than half that voltage must be fatal under the same conditions. This is well illustrated in the experiments recently undertaken. Dog No. 5, weighing 50 pounds, took in succession continuous currents of 1,100, 1,200, 1,300, 1,400 and 1,420 volts, the last the highest voltage at command, and a few minutes later 1,200 volts for 2 seconds, and was unhurt by any, skipping about as well as ever when released. Dog No. 6, weighing 55 pounds, was given a 300 volt current alternating 4,100 times a minute for 2 seconds, which caused him to howl and struggle, bite his tongue, and bleed at the mouth, then another of 400 volts for two seconds, then a shock of 500, and finally a 570 volt of alternating current for 3 seconds which killed him. During the latter three shocks the dog was silent and motionless. In dog No. 3, weighing 13 1-2 pounds, 1,000 volts continuous current was fatal, while dog No. 4, weighing more than three times as much, and with 5,000 ohms more resistance than No. 3, was killed by an 800 volt current alternating 2,200 times per minute.

The shocks by the alternating current caused more exhibition of pain, as manifested by greater howling and struggling after opening the circuit, than did those of the continuous current. But the more numerous the alternations per second the greater the number of powerful stimulations, and hence the more serious injury.

Dog No. 2 died from an 840 volt current alternating 1,600 times per minute applied for three seconds. He consequently received more than 26 voltaic alternations per second, or altogether about 80 voltaic alternations. Dog No. 4 died from an 800 volt current alternating 2,200 times per minute, applied for two and one-half seconds, or 91 in all. I am sure a smaller voltage would have killed that dog. Now, since each alternation of the current gives twice as great a shock as an interruption of the current, it follows that the more numerous the alternations of a powerful current the more decided will be its effect. Consequently by increasing the number of alternations per second, we should expect a smaller voltage to be fatal. This is exemplified in the case of dog No. 6, killed by but 570 volts, the number of alternations having been increased to a little over 68 per second, the duration of contact being 3 seconds. This dog, therefore, received 195 alternations. When, with dog No. 7 the E.M.F. was reduced to only 250 volts while the number of alternations was increased to 288 per second a contact of 5 seconds killed him at once. Dog No. 8 was killed with but 160 volts E.M.F., administered for 5 seconds, with 288 voltaic alternations per second.

It is, in fact, startling to see how small a quantity of E.M.F. is required, provided the alternations of the current be multiplied. In each dog the current was passed from the left hind leg to the right fore leg. The legs were thoroughly wet, wound with wet cotton waste, and bare copper wire to which the rheophores were attached, and the animal insulated in a dry wooden box, standing on a rubber mat. No external burns or lacerations were made by the currents in any of the cases. There was a tendency on the part of the shocks to diminish the number of respirations, and fatal shocks with either current caused respiration to cease before the heart stopped beating. No. 5, who took several severe continuous current shocks, and finally 1,420 volts, all that could be obtained in the laboratory, without injury, was panting at the rate of 120 times per minute, at one time, but several shocks reduced the panting to 60 per minute.

Most of the fatal shocks caused relaxation of the sphincters of the bladder and rectum, with involuntary discharge of their contents. Attaching the rheophores, as was done to the fore and hind legs, the current would by diffusion pass through the whole trunk, in all probability traversing all the important viscera, besides the larger nerves, the spinal cord, sympathetic system, and the pneumogastric and phrenic nerves. There is one muscle that would receive almost the whole of such a current, and that is the chief muscle of the respiration, the diaphragm, with the phrenic nerves distributed throughout its substance. It is possible that a paralysis or tetanic spasm of this muscle causes the immediate cessation of respiration. Dog No. 3 ceased to breathe in two minutes, while the right auricle of his heart continued to beat 36 minutes longer even after opening the chest. Dog No. 4 ceased to breathe in 15 seconds, while the heart beat for 10 minutes longer. Dog No. 6 ceased to breathe one and one-half minutes after he received the fatal shock, but the right auricle continued to beat subsequently for 10 minutes, and 3½ minutes longer under irritation. Autopsies were made immediately after death upon dog No. 3, which died from the continuous current, and on dogs Nos. 4 and 6, killed by the alternating. In all of these dogs the blood was dark and thin, in No. 4 so markedly that the muscles, liver, spleen, and kidneys seemed about black with engorged blood. Immediately after the death of No. 6 I examined some blood from its vena cava under the microscope, but found the red and white corpuscles normal in every respect.

The peristaltic action of the intestines on irritation and the mechanical irritability of the whole muscular system lasted in No. 3 over half-an-hour, and in 4 and 6 for 10 minutes. Current not having passed through the brain, that organ was not examined in any of the cases. All other organs were inspected in the three dogs. The lungs were normal in all. The heart was gorged with blood on the right side, and empty on the left in all. The movements of the heart were limited to the right auricle and its appendix. The abdominal viscera were normal save for their turgidity with blood. There were no extravasations of blood anywhere in them. I examined then the muscles of the legs attached to the rheophores. In No. 4 there were some operations of the thigh muscles and some extravasations of blood between them; in the other two dogs nothing of this kind. I removed for microscopic examination portions of a large nerve from the legs of all the dogs to which rheophores were attached, and also in No. 6 a sciatic from the sound side for comparison. From Nos. 3 and 4 I took several inches of the spinal cord in the dorsal region. Some of these I examined afresh and some after several days maceration in a solution of bichromate of potash. There was a slightly granular condition of the sciatic nerve of dog No. 3, this nerve lying so closely in a small dog to the electrode that in this instance it probably got the brunt of the current. The nervous parenchyma in other parts of the same dog was entirely normal. The substance also of the spinal cord was apparently normal, as viewed under the microscope. But in No. 3 I found the capillaries of the sheaths of the nerves under the spinal cord irregularly gorged with blood, and with here and there capillary extravasations; and this condition was even more marked in No. 4. It is a state known as capillary ecstasy due to paralysis of the walls of these minute blood vessels.

No. 6 died in a state of tetanic rigidity. There seemed to be no certain pathognomonic signs of death by electricity. The changes it produces are peculiarly protean. It enters the body dividing the molecules, separating the atoms, disarranging the fine molecular structure of the body, exerting both a chemical and mechanical action, now at one place, now in another, so that, as a rule, neither the eye nor the microscope is able to discover what vital centre has been disturbed or destroyed. It changes the colour of the blood by chemical action. It produces gross lesions in the organs by its expansive force, just as an egg or the head of a bird receiving the discharge of a Leyden jar by means of small wires inserted into its opposite sides, is blown to pieces.

REMARKS ON THE ARRANGEMENT OF ARC LAMPS.*

By DR. ST. DOUBRAVA.

THE simultaneous feeding of glow and arc lamps from one common source of currents is a problem on which years of work have been spent. Still, the installations hitherto carried out with parallel arrangements of glow and arc lamps prove that it is not yet fully solved. If the lamps are disposed two and two in parallel succession (fig. 1), the tension at the terminals amounts to $+ v - v$ 115—125 volts.

In single parallel dispositions the tension at the terminals of the machine is generally 65—75 volts. As the tension at the lamps rarely amounts to 40—50 volts the rest must be due to the rheostats introduced.

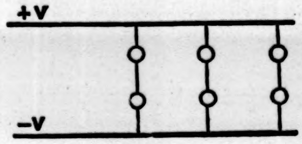

FIG. 1.

This circumstance renders the parallel disposition of arc lamps very uneconomical as compared with the serial disposal. We therefore ask why in a parallel arrangement so much power must be wasted by the introduction of resistances? The reason lies in the construction of the arc lamps employed and in the discontinuity of the electric arc. The last circumstance we will explain more closely. Three years ago I deduced from a series of experiments that the apparent counter electromotive force of the electric arc can only be explained by a discontinuity; but as I recognised the importance of this view in my studies on arc lamps, I did not publish the results of my experiments. Dr. E. Lecher therefore retains the merit of having first recognised this fact and of having published it.

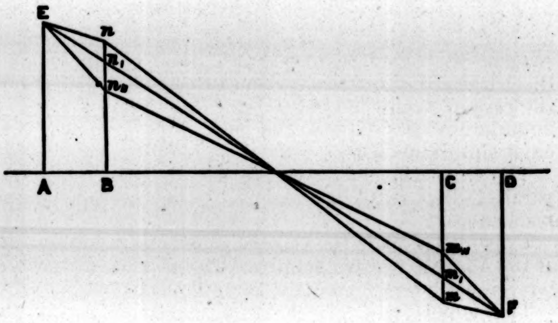

FIG. 2.

The discontinuity of the electric arc forms the reason why arc lights cannot be so easily disposed parallel as conductors in which the current is perfectly continuous. When the tension at the terminals remains constant the number of discharges per second is so much the greater the smaller the striking distance, and consequently the length of the arc. Fig. 2 gives a graphic representation of the phenomenon. Let A E, and D F, be the potentials at the terminals of the electro-generator, the resistance being supposed infinitely small.

Let A B, and C D, be the resistances of the afferent conductions, and B C the resistance of the arc.

If the flow of the current took place in the same manner as in a solid or liquid conduction, the distribution of the potential would be given by the right line, E, *n'*, *m'*, F. But, in reality, before the beginning of the discharge the distribution of the potentials is represented by the broken line, E, *n*, *m* F, and at the beginning of the discharge by E, *n''*, *m''*, F.

The resistance of the arc, therefore, before the discharge is greater than B C, but at the beginning of the discharge smaller than B C. If the times are plotted out upon the axis of the abscissæ, and the resistances upon the ordinates, the progress of the resistance will be shown by the curves, C A', C' A'', C'' A''' (fig. 3) where O B, B B', B' B'' represent the duration of a period of discharge. The apparent resistance measured is represented by the right line, m, n, parallel to the axis of the abscissæ, its ordinates forming the arithmetical mean of the ordinates of the curves mentioned.

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* *Zitschrift für Elektrotechnik.*

The greater the striking distance of the arc the greater is the accumulation at the ends of the carbon points necessary for striking over. At the same tension at the terminals the duration of a period of discharge will be increased the more the greater the striking distance of the arc. If two arcs are disposed parallel and if the resistances of the afferent conductions are too small in comparison with the resistance of the arc the case may arrive that the longer arc is extinguished.

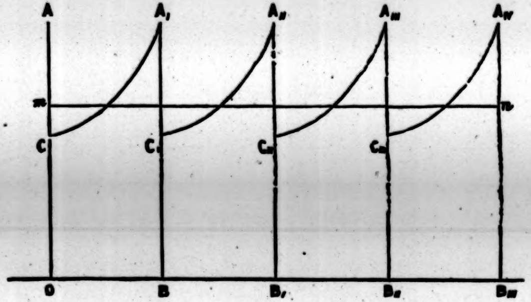


FIG. 3.

In the longer arc the distribution of the potential is represented by the broken line, E, n, m, F, in the shorter by E', n', m', F' (fig. 4). If the potential difference, $n'B' - m'C'$, is very small in comparison with that of $nB - mC$ the discharges of the shorter arc will follow so rapidly upon each other that the accumulation necessary for the longer arc to strike over is not attained and the light goes out. By the introduction of resistances in front the period of discharge of an arc can be prolonged. By the intercalation of resistances the discharges of the shorter arc can be so delayed that at the carbon points of the longer arc the necessary accumulation may be reached and then both arcs can exist simultaneously.

The exposition just given forms the principle of the parallel disposal of arc lamps by the interposition of resistances.

Uppenborn made the remark in an address delivered at the Vienna Electrotechnical Union that a good arc lamp must be a very sensitive ammeter.

This is perfectly correct, but an arc lamp should also be able rapidly to compensate differences which may occur in the strength of the current.

If arc lamps were so sensitive that they could at once compensate every variation, and if the resistances from the points of the carbons to the terminals of the electro-generator were alike in all lamps, we might dispose arc lamps parallel without being obliged to introduce resistances in front of them.

The same result would appear if all lamps would regulate with the same rapidity for the same difference in the current. But it is not possible to construct such lamps, and it is therefore necessary in parallel dispositions to place resistances in front of the lamps. The question is now, by what means and by what construction can the resistance introduced and consequently the consumption of power be reduced to a minimum. To this end I have examined the most different systems of lamps and have become convinced that the "mechanical lamps," *i.e.*, those in which the regulation is effected by gravitation by means of any mechanism, and in which the current determines only the beginning and the end of the regulation, however well and correctly they are adjusted, require in single parallel arrangements at least 65, but more commonly 70 volts in order to give a steady light. Here 45—47 volts are required for the lamp and the remainder for the rheostat introduced before it. In serial parallel introductions I could run down as a minimum to 115 volts, 90 volts serving for the lamps and 25 for the rheostat. In the former case an arc lamp consumes per ampère an effect of 65 volt-ampères, in the second case 57·5 volt-ampères. In the former case 30·7 per cent. and in the latter 18·2 per cent. of the power employed is lost. Of course this waste of power increases if we are obliged to have recourse to higher tensions in order to obtain a steady light.

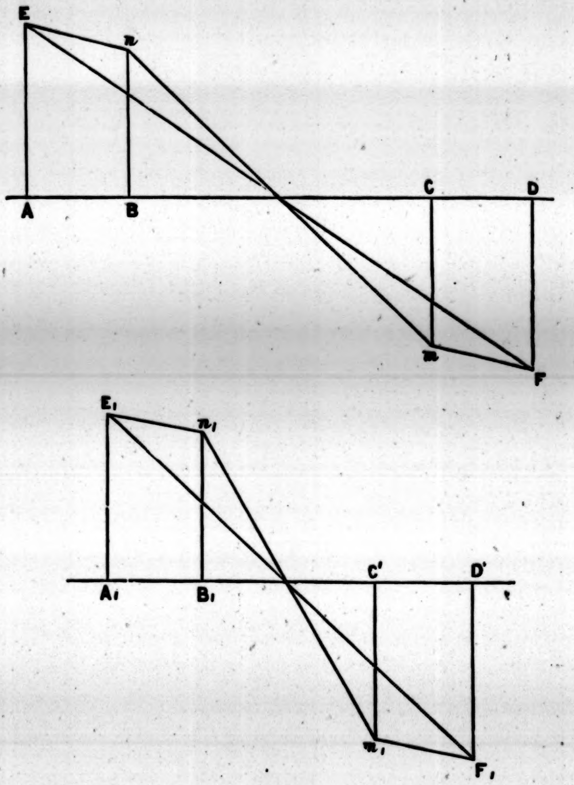


FIG. 4.

The loss of power is considerably smaller in arc lamps which act directly, as they are not only very sensitive, but are regulated much more rapidly than the mechanical lamps. The lamps constructed on my system in the establishment of R. Bartelmus, at Brünn, produce in single parallel grouping a perfectly steady light with 50 volts; in single parallel grouping they require only 100 volts tension at the terminals of the machine. They require, therefore, per ampère, an effect of only 50 volt-ampères, and the waste of power is only 10 per cent. These lamps are therefore more economical than the mechanical lamps by 11·5 per cent.

In order completely to avoid the loss of power by the proposed rheostats I have made experiments on introducing three lamps in series, and have succeeded with a tension of 125 volts at the terminals. In this case I consume an effect of 43·3 volt-ampères, and thus produce a perfectly steady light. This arrangement is more economical by 50 per cent. than a single parallel disposed with mechanical lamps and 32·8 per cent. more economical than a serial parallel arrangement with the same lamps.

National Time for France.—A *Daily Telegraph* telegram from Paris states that the French Government has resolved to fix one uniform time for the whole of the country. This will be "Paris time," which for the future will be adopted in railway stations and public places all over France, and it is to be called *l'heure nationale*. On the frontiers, however, there are to be quadrants marking both the Paris and the foreign hour. At the present moment three different systems of marking the time are in vogue in France. The new system will not come into operation until May next—that is to say, at the opening of the Universal Exhibition.

PRACTICAL NOTES CONCERNING THE CONSTRUCTION, USE AND MANAGEMENT OF STORAGE BATTERIES.

By A. RECKENZAUN.

(*Continued from page* 121.)

Propelling Electric Launches.

MUCH has been written and said about the adaptability of storage batteries to purposes of marine propulsion; nevertheless the question of weight of the battery is continually being reopened by persons interested in the subject. The hopes which were entertained a few years ago, and which still fondly cling to the breast of amateurs, that "some day" we shall have storage batteries of very light weight compared with great power, are gradually being dispelled. Structurally, secondary batteries have been much improved since the first electric launch made its appearance; but the attempts to reduce weight have failed, and it is admitted by all who give the subject serious consideration that the present most successful combinations have been determined after much practice, from which it is difficult to deviate without sacrificing some essential quality. For special purposes, where first cost and depreciation do not enter into calculations, we may yet wring a morsel from the possibilities which nature provides.

Theoretically, a comparatively large amount of energy is manifested in the separation of metallic lead from its oxide. According to Professor Reynolds, it equals 360,000 foot pounds per pound of lead acted upon, if every atom could be brought under the influence of chemical action. But in secondary batteries we cannot use the material in such a finely divided state; we require a support, which must also be a conductor, and this, with the acid and a suitable receptacle, brings the weight up to over ten times the value given in chemical equivalents. Several years practical experience point to the conclusion that secondary batteries of sufficient mechanical strength and durability cannot yield much more than seven watt-hours per pound weight of material. This includes plates made of lead and oxides of lead, acid, cell and terminals; and these figures are based on the assumption that the rate of discharge does not exceed three-quarters of an ampère per pound of accumulator, or approximately one ampère per pound of plate. At this rate it is possible to maintain an average E.M.F. of at least 1·87 volts per cell for the entire useful discharge period.

A pleasure launch of 30 feet length, 6 feet beam and 2 feet draught of water can be driven at a speed of from six to seven miles an hour in still water, with an expenditure of about 3,000 watts, through an efficient motor actuating an efficient screw popeller. A continuous run for six hours would thus necessitate a battery of 2,571 lbs. weight, consisting of 60 cells, if each were to weigh 43 lbs.

Seven miles an hour may be considered a moderate speed. It is, of course, possible to travel much faster than this, but at an enormous sacrifice of energy. Each additional mile involves an increase of power altogether out of proportion to the gain in speed. To illustrate this we may cite an example from carefully conducted speed trials on the measured mile at Long Reach in April, 1886, under the auspices of Messrs. Yarrow & Co. and the naval attachés of the Italian Government. The launch in question was built of steel on the most approved lines; it was 36 feet long and of 6 feet beam; her storage battery consisted of 73 cells. With 53 cells in circuit an average speed of 7·51 miles per hour was attained, and when twenty extra cells were switched into circuit the average speed came to 8·43 miles per hour, showing an increase of only ·92 of a mile per hour with 37·7 per cent. more E.M.F. Theoretically, the power required to drive a boat varies as the cube of the speed. Great speed, therefore, can only be obtained with a high current rate, which means a very rapid discharge of the cells and a correspondingly early destruction of the plates. There is scarcely any advantage gained by increasing the size of the battery if the same is already as heavy or heavier than the hull and live load combined; consequently the limit of speed in any electric launch has to be determined by the limit of the current which the accumulator is capable of giving off at any time.

With regard to the space occupied by a lead battery yielding seven watt-hours per pound weight, this we find to be about one cubic foot per 1,000 watt-hours. The cells in the 30 feet boat above referred to, with a capacity of 3,000 watts for six hours would then occupy 18 cubic feet, or if the height of the boxes over all is 1 foot, the necessary floor space must be 18 square feet. Confining ourselves to small vessels, which come under the category of "launches," driven by lead storage batteries, we may safely assert that these can never be propelled at a speed of more than 15 miles an hour, no matter what sacrifice we make; furthermore, it may be stated with equal certainty that the distance that can be traversed with one charge of batteries in still water will not be more than 100 miles, at a speed of not less than four miles an hour. Within these limits, however, there is a fruitful field for further developments, and the steps taken by Messrs. Immisch in establishing charging stations up the river are likely to cause a demand for boats propelled by electric energy.

Effect of Shape of Propeller upon Rate of Discharge.

One of the most difficult parts of a launch is the screw propeller. Almost any kind of screw will push a vessel through water, but with different samples results of a varying kind may be obtained. In order to ascertain the merits of some, we made a series of experiments, five years ago, with three screw propellers on a small launch. It will be observed that in each experiment there were considerable differences in the current and number of revolutions, although the same battery and motor were used in every case. Each screw had only two blades; the dimensions were as follows, distinguishing them by the letters A, B and C:—

	A	B	C
Diameter in inches	19·875	18·75	17·75
Mean pitch in inches	12·9	12·25	11·5
Disc area of blades, square inches ...	94	76	59
Whole disc area, square inches ...	314	276	247
Expanded area of blades, sq. inches	103	82	66

Table XI. gives the mean results of the tests with each screw, and it shows that the work done does not vary in proportion to the energy expended upon it. The relative work of the screw is assumed as proportional to the number of revolutions, and the relative energy consumed varies with the current.

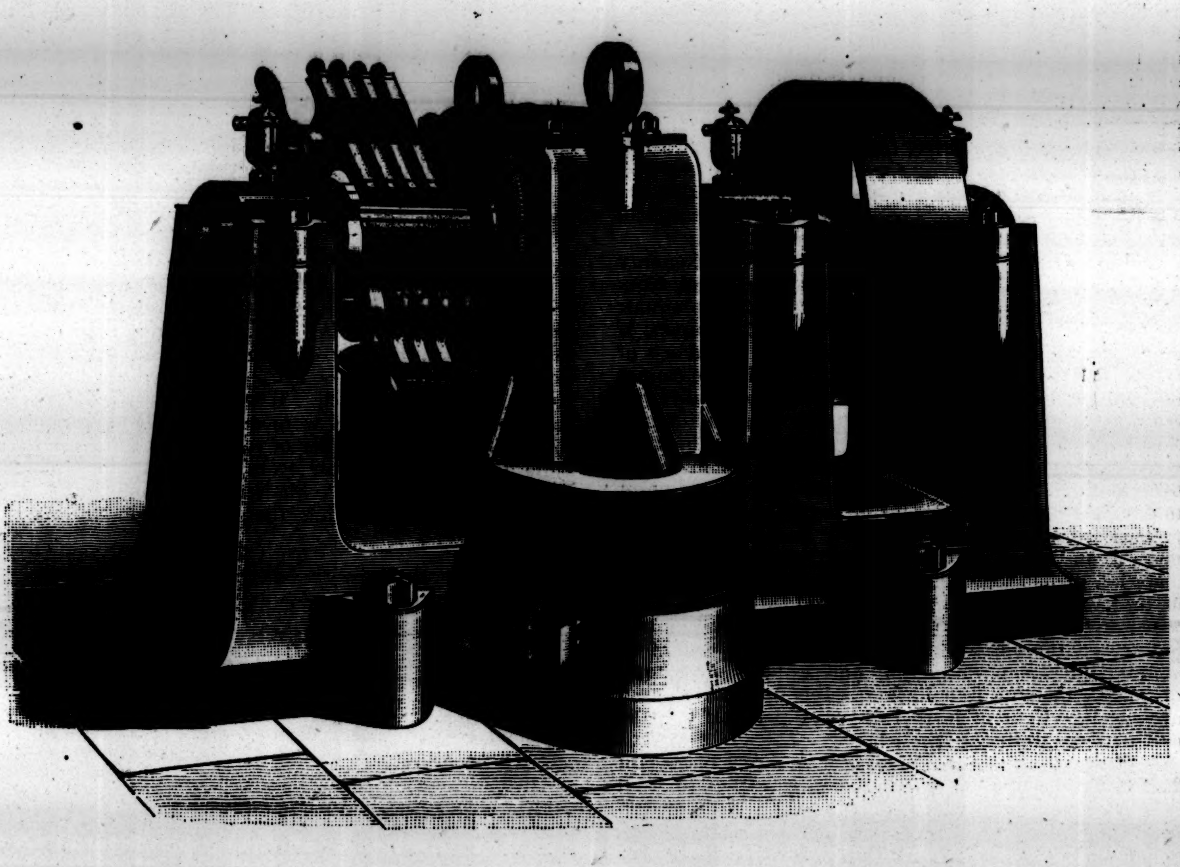
TABLE XI.

Number of experiment.	Revolutions per minute.	Relative work of screw.	Current in ampères.	No. of cells.	Electrical horse-power.	Relative electric energy.
			A			
1	599	1·00	48·8	40	5·76	1·00
2	630	1·05	57·2	45	7·6	1·30
3	830	1·38	63·5	50	9·36	1·62
			B			
4	684	1·00	40	40	4·71	1·00
5	748	1·09	46	45	6·1	1·29
6	880	1·28	52	50	7·66	1·62
			C			
7	738	1·00	29	36	3·07	1·00
8	786	1·06	30	41	4·35	1·41
9	840	1·13	43	46	5·6	1·82

(*To be concluded.*)

THE COVENTRY DYNAMO.

THE Coventry dynamo is manufactured by Messrs. Stafford and Eaves, of the Volt Works, Coventry. The machine is of the "Kapp" type, with single circuit magnets. The armature is of the ring type, built up of thin discs of charcoal sheet iron ·05 inch thick; the discs are insulated with varnished paper; they are supported on phosphor bronze radial arms in such a manner that it is impossible for them to come loose, however great the strain to which they may be put. In all sizes of these machines there is only one layer of wire on the armature; the makers do not depart from this rule even for an E.M.F. of 3,000 volts. In the medium and large sizes, driving horns or projections are provided for carrying the armature wires through the resistance of the magnetic field. In the machine shown in the illustration the field circuit is entirely of cast iron, specially selected metal being used for the purpose.



The weight of a machine built in this manner is of course greater than if wrought iron field magnets were used; but the makers contend that the question of weight is one for the manufacturer alone, and that the first consideration should be to build the machine strong enough to easily withstand all strains to which, in its everyday work, it may be subjected.

The brushes are of a special form, having circular and pressure adjustment, the motion of the brush being parallel to its length, so that the angle of contact with the commutator is always the same. A large number of brushes of various sizes and material have been tried, but the three following have given the best results—thin copper strips alternated with copper wire, soft brass wire, and wire gauze. A large surface of brush is employed, and the pressure being light, a set of brushes will, with care, last three or four years of ordinary lighting work. The commutators are of ample size; the bars are cast from a special alloy of great durability; the sections of the commutator are insulated with mica.

In special cases, such as ship lighting and export, where lightness is an advantage, the field magnets are made entirely of wrought iron.

The following figures relate to a 30-unit shunt wound machine:

E.M.F.	110 volts.
Current	350 ampères.
Speed	600 rev. per min.
Res. of armature (warm)	·007 ohm.
Res. of F.M. coils (warm)	15·7 ohms.
Loss in armature	960 watts.
Loss in F.M. coils	770 watts.
Useful output	38,500 watts.
Electrical efficiency	96 per cent.
Commercial efficiency	92 per cent.
Volts per yard of armature wire ...	1·1 volts.
Useful output per lb. of copper on armature	370 watts.
Current density in armature wire ...	2,800 amps. per sq. in.
Current density in F.M. wire ...	800 amps. per sq. in.
Magnetic induction ...	18 Kapp lines per square inch of armature core.

In addition to machines for incandescent electric lighting, Messrs. Stafford and Eaves also manufacture shunt wound constant current arc lighting dynamos capable of running from 5 to 60 2,000-C.P. lights in series, self-regulating electro-motors of from ¾ to 70 brake H.P., and heavy current dynamos for electroplating, refining, &c., of from 150 to 3,000 ampères capacity.

LIGHTNING.

By S. A. VARLEY.

(*Continued from page* 174.)

IN last week's issue I made reference to certain experiments carried through by me to ascertain the law which induction followed. The method I adopted, and the results obtained with flat plates and also insulated circular conductors, were described in detail in a paper read before the Society of Arts in March, 1859, and published in their transactions.* In the course of the description I state: "When a galvanic battery is connected with the inner and outer coatings of a Leyden arrangement, induction will take place through the dielectric, and if the surfaces of the two coatings are equal, then the force will be equally divided over them, that is to say, if the battery force be 100, the tension of the charge on the one coating will be 50, and that on the other will be 50 also = 100. Let the surface of the outer coating be infinite in extent, then the tension of the charge on the inner coating will approach infinitely near to 100, and the tension on the outer coating will be almost nil. An example of this we have when the earth represents one of the coatings of a Leyden arrangement, and this is the case in the prime conductor of a frictional machine, and also in the suspended wire of the telegraphic circuit. In these two examples the prime conductor of the machine and the wire of the telegraphic circuit represent the one coating, the air the dielectric, and the earth the other coating."

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* This paper was reproduced in the ELECTRICAL REVIEW of May, 1884.

Assume a Leyden arrangement consisting of two metal plates, the surface of each of which say = 100, and the space separating them = 1.

If we charge one of these plates, which we will call No. 1, with negative electricity to, say a potential = 100, this negative charge will be balanced by a positive one on No. 2 plate having a + potential = 100.

Now reduce the surface of No. 2 plate to 10, and charge No. 1 plate as before with negative electricity to a potential = 100, this negative charge will be balanced by an equal amount of positive electricity on No. 2 plate; but as the surface of No. 2 plate is only $\frac{1}{10}$th that of No. 1, the positive electricity accumulated on No. 2 plate will be 10 times as dense as that of the negative charge, and therefore it will have a potential = 1,000, or to state it differently, it will have 10 times the force to break down the dielectric, and so bring about discharge.

If No. 2 plate were further reduced to a surface = 1, then the positive potential would be 100 times that of the negative charge accumulated on No. 1 plate, and if this negative potential, as assumed in the former examples, = 100, then the positive potential would = 10,000.

Here we have a simple explanation, which I think has been overlooked, of how it is that a needle point will discharge a charged Leyden jar through a very considerable space of air. If we could conceive a Leyden arrangement in which the metal plate of smaller surface was a mathematical point, it would be impossible to charge it, as the potential of a mathematical point would be infinitely great in all cases.

Now let us perform the experiment in a slightly different manner. Assume a second Leyden arrangement in which the surface of No. 1 plate = 1,000, the surface of No. 2 plate = 100, and the space separating the plates = 10. Assume that No. 1 plate has been negatively charged to a potential = 100.

The thickness of dielectric which will now have to be broken down for discharge to occur will be ten times that of the first example, where the space separating the positive and negative plates = 1, and the surfaces of both plates were equal to one another; but as in this case the negatively charged surface has been increased to ten times that of the positively charged surface, the positive electricity will be ten times denser than the negative charge, and consequently it will have ten times the potential; in other words, ten times the breaking-down power; so we see increasing the area of one of the inductive surfaces of a Leyden arrangement facilitates discharge between oppositely charged surfaces and produces in effect a similar result as diminishing the space dividing them. The experiments above described harmonise with the electro-magnetic experiment referred to in an earlier portion of this article, where a soft iron core was wrapped with two sets of convolutions of insulated wire; and, further, these experiments, I think, throw light on the *modus operandi* of a Winter's ring when mounted on the conductor of an electrical machine, the action of which, as far as I know, has never been clearly explained.

When considering phenomena associated with electricity of high potential, such as that developed by a Wimshurst influence machine, the part which the dielectric itself plays should not be overlooked. Atmospheric air, as is well known, is a very perfect insulator; but, at the same time, it is a mobile one, and capable of having currents set up in it; moreover, there is always more or less matter in a fine state of division suspended in it, which acts the part of a carrier, and by electrical attraction forms a continuous chain of more or less semi-conducting material, which helps to electrically bridge the space separating oppositely charged surfaces, and when the tension is sufficiently high, I am disposed to think actual electrolysis, or certainly something approaching to it, occurs. I have already pointed out that two platina plates, separated by an electrolytic liquid, are a Leyden arrangement with a dielectric of low resistance, requiring a low electric potential only to break up its organisation, and that what we see actually occurs in such a Leyden arrangement enables us to comprehend what electricity of very high potential is striving to bring about in the matter composing dielectrics, such as glass or atmospheric air. In a Leyden arrangement, formed by platina plates in an electrolytic liquid, we have oxygen in a condensed form adhering to one of the platina plates, and hydrogen, also in a condensed condition, adhering to the second plate.

If with the aid of electrolysis we deposit platina in a fine state of division on the platina plates, so as to cover their surfaces with minute angular or pointed particles, the adhesion of the oxygen and hydrogen to the platina will be very much reduced, and the gases developed by the disorganisation of the dielectric will leave the electrodes as fast as produced. I am not aware of any explanation of this well known fact having been attempted. I, therefore, venture to suggest one which is simple and harmonises with other observed electrical phenomena.

When smooth plates are employed continuous sheets of the condensed gases are deposited on them and held there by cohesion, but when the surfaces consist of numerous small pointed particles, these projections become coated with the oxygen and hydrogen not in continuous sheets, but in minute detached masses similarly electrified, electrical repulsion between them therefore occurs, and the cohesive force which held the gases in the case of the smooth plates is overcome. The smooth plates of continuous surface act analogously to what is observed when soft iron cylinders and solid metal rods are employed for electro-magnets and electrical conductors, and the platina surfaces consisting of numerous angular particles act analogously to what is observed when a bundle of fine iron wires and a bundle of copper wires are employed for electro-magnets and electrical conductors. I attach importance to such harmonies which seem to me to stare one in the face, and are to be found in every direction if we only look out for them, because they act as finger posts pointing out the direction for research, and they also enable us to criticise and often to correct detached and imperfectly observed phenomena.

When we have two wires suspended in the air, and highly charged with opposite electricities, the atmosphere dividing them is in a high state of electrical polarisation, and the oxygen and nitrogen probably also become condensed and adhere to the oppositely charged conductors much in the same way as that observed in the case of polarised plates in an electrolytic liquid. We have evidence of what is here suggested in the production of ozone wherever electricity is being developed by influence machines.

It is, of course, well known that polarised metal surfaces will develop currents by reaction, and a similar but much more rapid reaction must occur immediately after the discharge through the atmosphere of highly excited conductors, especially in those whose surface and length is great relatively to their mass, and I venture to suggest that what I have called attention to may help to account for some phenomena observed by Prof. Lodge in the course of his experiments. Mr. Wimshurst informs me that if bare wires be suspended in the atmosphere, and charged by one of his machines in a darkened room the surface of the wires will be seen to have become luminous throughout, and dotted over with innumerable bright stars, showing an active transmission of electrical energy is taking place through the atmosphere. He also informs me the same phenomena are observed, but in a less degree, with suspended wires coated with gutta-percha, unless the coating be a thick one, in which case no such appearance will be visible.

In the continuation of my remarks in the next issue of this journal, I propose to make the few comments on Prof. Lodge's experiment which I feel permitted to do, and to say a few words on the subject of lightning discharges and lightning conductors.

(*To be continued.*)

NOTES.

Electric Light Fittings.—Electric lighting seems eminently adapted to give a draughtsman free scope for the exercise of his artistic abilities in designing elegant fittings, and the other day we had the opportunity of inspecting some very beautiful floral designs in centre pieces and brackets for electric lighting installations. They are the productions of Messrs. Lea, Sons & Co., of Shrewsbury, and are manufactured true to nature in hammered iron and copper, no machine work being allowed to enter into their construction. We cordially recommend contractors to inspect the wares of this firm before deciding upon their orders, for we feel convinced that however strange it may appear they will here find something which departs from the *beaten* track.

Cheltenham and the Electric Light.—The electric lighting committee of the Cheltenham Town Council reported at the last meeting that it was desirable to try the experiment of lighting a portion of the town with the electric light, that the area to be lighted be High Street from Hales Road to Gloucester Road, Colonnade to Lansdown, and Clarence Street to the end of Manchester Street. It was considered that 36 electric lamps each of 1,200 C.P. would be sufficient to efficiently light that area, and that 170 gas lamps would be rendered unnecessary. Mr. Norman strongly urged the adoption of the report, concerning which the committee was unanimous. He pointed out the advantages of the electric light, and recommended the Corporation to take the work into its own hands, rather than allow it to be monopolised by a private company. He also suggested that underground wires should be used. The recommendation of the committee was carried without opposition.

Johore and the Electric Light.—It is said that His Highness the Sultan of Johore, G.C.M.G., K.C.S.I., &c., has commissioned Dato James Meldrum, Edinburgh, to visit the Glasgow Exhibition and report on the subject of electric lighting. The Sultan intends to light the town of Johore with electricity.

Electric Lighting Tenders.—Tenders are invited for lighting the district of Cowpen, Northumberland, by electricity for periods of five and seven years respectively, both by the arc and incandescent systems. Particulars can be obtained from the surveyor to the Cowpen District Local Board, Commercial Buildings, Waterloo, Blyth. Tenders to Mr. M. W. Sidney, Blyth, by September 1st.

Tenders are also required for lighting a certain area of the City of Exeter by electricity for an absolute term of seven years. Plans and conditions from the City Surveyor's office, on payment of two guineas, returnable on receipt of a *bona fide* tender. Tenders to the Town Clerk by September 22nd.

Dalkeith and the Electric Light.—At the monthly meeting of the Dalkeith Police Commission on Monday night, Bailie Watson remarked that now that Dalkeith had got such a powerful gas engine, some of its great power should be utilised so as to be of some more benefit to the community. He believed it would be beneficial for the community at large if it could be used for the purpose of producing the electric light as well as for pumping water. He believed the engine to be capable of doing both, and if so, then their town, their business premises, and their dwellings, to the surprise and admiration of all, would be lighted with a light somewhat approaching the light of the sun in purity and splendour, and for this end he asked them to appoint a committee. Provost Gray did not think such a project was suitable in such a small place as Dalkeith; they should wait and see the results in other places. Bailie Murdoch said he felt rather inclined to sympathise with Bailie Watson's idea; and after some further conversation a committee was appointed to make the necessary enquiries with the view of accomplishing the object.

The Electric Light on Dartmoor.—The batteries of artillery at present in camp are now engaged in experimental practice, and three or four nights last week were employed in endeavouring to destroy the electric lighting apparatus which has been erected at the base of Mill Tor, but without effect up to the end of the week. Early in the present month a party of engineers arrived from Chatham with a traction engine, to which a dynamo is attached, and the apparatus has been fixed underground between Black Down and Mill Tor. The light is procured from an arc lamp of 5,000 candle-power.

Richmond and the Electric Light.—At the last meeting of the Richmond Vestry, the following letter was read from Mr. R. F. Coles, on behalf of the proposed Richmond Electric Lighting Company:—"Referring to previous communications which have, I believe, been placed before you, I now beg to say that with every desire to work in harmony with your Board, and with the object of carrying out the wishes of many of the largest ratepayers, I am now prepared to make you the following proposition, viz.: That in consideration of your transferring, or delegating to me, on behalf of the company, the Provisional Order and powers you hold from the Board of Trade for electric lighting within this area, and your giving me any necessary assistance to have this order altered or substituted for similar powers under the new Act, and your further guaranteeing me your entire co-operation and support in the matter of electric lighting in this district, my company would either pay you a royalty of one shilling (1s.) per light per annum (street lamps by special contract), or if preferred would undertake to give you a fixed sum, say, one hundred and fifty pounds (£150) per annum for consideration of the said transfer of license. I will of course satisfy you as to the *bona fides* of the undertaking, and if you are disposed to vary this proposition in any way, or make me a counter proposal, it will meet with my careful attention. If desired I would agree that two members of your Board have seats on the direction of the company. I may mention that I have orders in hand for some 2,000 lights, and only desire your sanction before commencing the erection of a central station on the proposed suitable site." The letter was referred to the Parliamentary Bills Committee.

Lighting Waggon Works.—Mr. Hammond informs us that his company has received an extensive order from the Great Northern Railway Company to light its new waggon repairing shops and offices at Doncaster. The plant to be supplied consists of three horizontal steam engines and three dynamo machines, and the lighting will be effected by means of 70 arc and 200 incandescent lamps. Storage batteries will be provided to supply the incandescent light to the offices, as the machinery will not be constantly running.

The Telephone at the B.A. Meeting.—By the courtesy of the directors of the Western Counties and South Wales Telephone Company the whole of the section rooms during the Bath meeting of the British Association will be telephonically connected with the reception room, and, through the Telephone Exchange, with all important places in the neighbourhood, free of any expense to the Local Executive Committee or members and associates for the meeting.

Telephones and Temper.—A German physician is said to have discovered that excessive indulgence in telephonic communication causes a peculiar disease of the ear. It also brings on total loss of the temper and promotes expletives. Evidently the telephone has never been educated up to the point of understanding that a soft answer turneth away wrath.

New Zealand Cables.—According to information from New Zealand, the *Sherard Osborne* was busily engaged when the mail left grappling for a portion of the broken cable in Cook's Straits. By some means they had secured the single wire cable from Wellington across the Straits and broke it. The whole of the work for the large centres in the South Island was by this accident thrown upon the cable from Wanganui.

Telephone Lines and Heavy Electric Currents,—The German Society of Electricians in November last appointed a committee to investigate the conditions under which telephone circuits can be efficiently operated in the neighbourhood of cables carrying heavy currents, such as are used for electric lighting and transmission of energy. The problem put before the committee was formulated as follows:—(*a*) How are telephone currents influenced by heavy electric lighting and power currents in their neighbourhood? and (*b*) what conditions of installation and working heavy current circuits should be observed in order to avoid interference with neighbouring telephone circuits? The general conclusion arrived at by the committee is that it is not possible to give the precise limit for the distance at which parallel telephone circuits and cables carrying heavy currents should be placed in order to avoid interference, but that this distance should be made as large as possible, not only to reduce induction, but also with regard to the greater mechanical safety of the telephone circuits. Where alternating currents are used, interference can be avoided only if both the positive and negative mains are equi-distant from the telephone circuit, a condition which is fulfilled by the employment of the Siemens concentric cable. The same arrangement is also advisable where continuous currents are used. Interference is avoided if the telephone circuit is operated with a metallic return placed close to the outgoing wire. The report concludes with a recommendation that telephone and electric light or power circuits should be placed as far apart as possible, and should be protected by a metallic armature. Not much additional knowledge has been obtained by the committee's labours, which seem only to corroborate generally accepted views on the subject; but a hint might be taken by cable manufacturers for the construction of conductors.

Electrical Measuring Instruments.—We hope to publish very shortly an illustration of a new electric light switch, and a very simple form of rheostat. Both instruments are excellent specimens of their class, and we think will be highly appreciated in electrical circles.

New Lamps for Old Ones.—We hear wonderful accounts of the latest form of Woodhouse and Rawson incandescent lamp, and we have no reason to doubt their accuracy. Flashing filaments is a good thing in its way, and is absolutely necessary for imperfect threads; but when the conductor can be turned out in a most perfect and homogeneous form throughout, which is we understand accomplished by the firm named, the process becomes no longer necessary.

The Medical Press and Quackery.—The *Provincial Medical Journal* has apparently a livelier consciousness of the duties of the medical press and profession in regard to that ubiquitous pest, the quack "medical electrician," than many of its congeners, for, by an advance proof courteously sent us, we see that the September number will contain a capital article ridiculing the quack and his customers, satirically likening the present generation, with all its education and enlightenment, to the people of the Dark Ages in its abandonment to the worship of fetishes and amulets. After remarking upon the fatuous conduct of even educated people, who wear "electric belts" and believe in their efficacy against all human ills, notwithstanding the assurances of electricians that these belts contain and generate no electricity, who wear skeins of silk across their chests and place small pieces of sulphur in their boots to keep off rheumatism, and who are only too ready to write a testimonial for the benefit of the charlatan, our contemporary asks: "Can we suggest a remedy? Education is at the present day the panacea for all our ills; but education we fear cannot help us. . . . . Experience tells us that amongst the ministers of religion are to be found the staunchest supporters of the various forms of quackery which at the present day flourish in Great Britain, so that we cannot look hopefully to any help from education. . . . . We can only fall back upon the explanation which holds true of the African. They are ignorant and superstitious, and in modern times they still worship a fetish. If credulity be the test, the Middle Ages are not yet over." We are reminded by the presence upon our table of the March number of the *Provincial Medical Journal* that this is not the first time our contemporary has devoted its columns to the denunciation of electro-quackery. It published at the beginning of the year a series of articles by Dr. W. E. Steavenson, who has charge of the electrical department at St. Bartholomew's Hospital, on "The General Practical Uses of Electricity in Medicine and Surgery," in which were many strong protests and appeals to the profession to discountenance sham electrical appliances. The *Lancet*, too, about the same time helped to expose electro-quackery by publishing an article based upon our description of the "electropathic belt."

Electric Locomotion.—We have received a very long letter from a Mr. Weise on the subject of the Elieson system of locomotion, in which he makes statements of a nature impossible for us to publish unless supported by other testimony. We must have confirmatory evidence of an indisputable nature that all his assertions are correct before we can give them credence. At first we felt inclined to ventilate his opinions on the matter, but from information which has just come to hand, we have every reason to decline, at least for the present, the publication of his communication.

Telephone Troubles.—We have received the fourth edition of a little American pamphlet entitled "Telephone Troubles, and how to find them." It is published by C. H. Haskins & Co., of Milwaukee, at 10 cents. per copy, or $6 per 100, and it contains a vast amount of practical information in the brief compass of 32 pages. We think that telephone operators in this country would be benefited by its perusal.

Iron Clad Armatures.—We believe that by the time the REVIEW meets the eyes of its readers the Crompton-Swinburne alternating current dynamo will have undergone a preliminary trial. We are much interested in knowing the result, although we feel inclined to stand by the opinions we have given in our leading columns on dynamo variations.

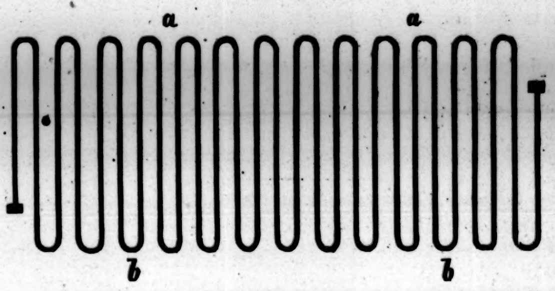
Edison and Swan United Electric Light Company *v.* Shippey Brothers.—We are informed that Mr. Arthur Shippey has paid the taxed costs of the Chancery proceedings incurred in this matter. This places Mr. Shippey in a position to commence a fresh suit.

Bankruptcy.—An application was made by G. Collett to Mr. Registrar Linklater for his order of discharge. He was a member of the firm of Huon and Collett, opticians and electricians, 52, Hatton garden. A receiving order was made on June 25th, 1886, on the debtor's petition, and they submitted accounts showing £5,070 14s. 2d. liabilities, and assets valued at £953 12s. 4d. The official receiver's report stated that proofs had been made for £5,008 4s. 3d., and that Mr. Arthur Cooper, of 14, George-street, Mansion House, the trustee appointed to the estate, had reported the assets had realised £374 19s., and that a first and final dividend of 10d. in the pound had been declared. The report further stated that Collett resided in Paris; that Huon was started in business in March, 1884, by a firm in Paris by whom he had been previously employed as manager, and that in the following October he was joined in partnership by Collett. Neither of them had any capital, but a sum of £800 was borrowed from a relative of Collett's, and has never been repaid. The firm in Paris, before referred to, have supplied the whole of the goods with which the bankrupts carried on the business, and appear as creditors for £4,147 7s. 5d. The failure was attributed to the stoppage of the supply of goods by the said firm, and to the profits having been insufficient to meet the expenses. The offences charged were insufficient book-keeping, and that the course of the bankrupt's trading had been rash and unjustifiable. Mr. Todd appeared for the bankrupt, and stated that he resided in Paris and came over here for the purpose of passing his public examination. The learned registrar said that only the offence of insufficient book-keeping had been proved, and on that ground the order of discharge would be suspended for six months.

Attack on the Glasgow Exhibition.—The Glasgow *Evening Citizen* narrates an interesting incident which occurred near the exhibition now open in that city last Saturday, "after nightfall." "When it became almost totally dark, and the lamps were lit on the banks of the Kelvin, on the two bridges which afford access to the main entrance, and on the Prince of Wales Bridge beyond, a voyage in the electric launch, or in any other species of craft, was a most enjoyable and novel sensation. Each bank of the river was a sort of fairy land, through which the darkened boat silently glided. As the little vessel returned towards the lower wharf, creeping quietly through the water, it might fitly be compared to some phantom spider, bent on its errand of destruction, and preparing to open fire on the exhibition. The resemblance was heightened by the use of the search light, which, though often shed with marvellous brilliancy on the water and river banks, failed to hit the boat until she was almost within an oar's length of the pier. Supposing the launch to have carried an attacking party, the defenders of the great show would have had but a poor chance of protecting the property. The enemy had the best of it as well, in the beauty of the scene presented by the lighting of the banks and the general surroundings."

Dangerous Electric Currents.—In our next issue we hope to deal somewhat lengthily with the excitement which has been produced amongst the electrical fraternity in America over the experiments of Mr. Brown in dog killing by electricity. It is difficult to see, however, what good service to the cause of humanity the sufferings of these animals will render. With vivisectionists we have every sympathy, for the results obtained from experimenting upon the lower animals may be directly applied to the good of mankind, as, for example, the treatment of hydrophobia by the famous Mons. Pasteur, but we cannot see that the death of a dog from an electric shock will be of any value in determining the limit of E.M.F. and current which will prove fatal to human beings, as the conditions under which the shock is received will never be the same in the two cases.

A Magnetic Sleep Inducer.—The sketch below illustrates the charm which our friend of last week brought to us as having been purchased by a lady for the purpose of inducing sleep, although we believe it is claimed that this simple little zigzag piece of wire, finished off at each end with a small brass washer, will be found efficacious in all ailments. The wire shows traces of magnetic polarity all along the sides, *a* and *b*, of course of opposite character. It is wapped up in a material which looks like a strip of coarse flannel, and finally enclosed in a red bag. How wonderful are the effects of magnetism upon the female form divine may be judged from a condensed account of a young damsel's suffering, which we cull from the page of a little magazine which has been sent to us. Miss Bond was a needlewoman, and became very ill. Her occupation was then changed to that of magnetising these wire grids, and in one month's time she had so far improved as to be scarcely recognisable. She again returned to needlework, and became worse than before—so bad, indeed, that she was about to resign her position when it suddenly struck the gentleman who was responsible for her engagement that the mere handling of powerful magnets might have influenced her health. Shewas again set to magnetise the grids, with the same result as formerly. Still more wonderful to relate, she returned finally to her sewing, this time wearing a magnetic appliance made of two No. 5 Parkes's magnets, and during the rest of her time in that employ her health remained good. We hold firmly to the opinion, however, that Miss Bond had only "got the needle," a very prevalent but easily relieved malady. A footnote relative to this case is too good to be lost:—



> A Parkes's magnet is, in one way, like a bottle of medicine—it only lasts for a certain time; but it has advantages not possessed by a medicine bottle—it only requires to be refilled every year or year and a half, and then there is no charge made for it.

Probably the original cost covers the giving away of magnetism free of charge. Wonderful philanthropy!

Lecture.—On Friday evening, September 7th, at 8.30 p.m., a discourse, illustrated by experiments, will be given in the Drill Hall, Bath, by Prof. Ayrton, F.R.S., on "The Electric Transmission of Power." We understand that the lecture will be illustrated by all the most important methods of economically transmitting electric power by the use of direct current or alternate current transformers.

The Elieson Accumulators.—We learn from a Philadelphian report that during the whole time the Elieson electric locomotive which went to America some months ago has been in operation, only two single plates of the 100 cells taken out have been replaced. This speaks well for their construction, for the curves and gradients on the American lines are said to have taxed the engine far beyond anything on the Stratford-Manor Park tramway. We may add that the locomotive, which made a number of trips in the streets of Buffalo, has since been tried on Philadelphian tracks.

Dynamo-Electric Machinery.—The latest edition of Professor Silvanus Thompson's book on "Dynamo-Electric Machinery" has been received by us, and will in due course be reviewed in our pages. A casual glance appears to reveal the fact that it has now more nearly reached perfection.

Galvano Bob.—We wonder if any of our readers ever heard of "galvano bob," and if so, whether they mentally imagined the term to apply to some daring lightning rod erector! In any case we are in a position to place all their doubts at rest, for "galvano bob" is "a perfect galvanic battery to be worn under the heel in each boot." It is said to surpass all other appliances of the kind, for being placed at "the base of the two pillars of the frame there is at once a continuous current of the electric fluid pasing through and acting upon every part, imparting vitality and vigour to the entire system, effecting cures in all rheumatic and many other afflictions, giving relief in all disorders, and in no case can it be injurious." The price of the article varies from 1s. per pair in the case of children under seven (will those who are "more than seven" ever purchase one?) to 1s. 9d. for extra large feet. We have dissected the article and find three thin plates of zinc about the size of half-a-crown with a piece of thin copper wire spirally coiled between each. There is absolutely nothing to separate the two metals, so that when in their canvas case, which completely covers them, the whole thing is jammed into one metallic mass. We thank the correspondent who took the trouble to obtain this *patented* article for the purpose of submitting it to our inspection, and we have no hesitation in saying that those people who by its means are now attempting to wheedle the "bobs" from the confiding and unsuspecting public ought to be thoroughly ashamed of themselves. One might just as well place a penny on a piece of zinc of the same size and place the combination in the shoe. The manufacturer of this idiotic appliance, which can well be made for one penny, is Mr. J. Court, who is also, we understand, the patentee. Could not the Patent Office officials help to put a stop to this nefarious trade by refusing to pass specificatious of this kind?

The Metropolitan Electric Supply Company.—We alluded a fortnight ago, says *Money*, to the unseemly haste with which the prospectus of the Metropolitan Electric Supply Company, Limited, was rushed upon the public. A correspondent, who signs himself "A Miserable Investor," sends a piteous letter to a contemporary which throws a strong light on the tactics resorted to in the flotation of that concern. Induced by the glowing puffs which were circulated before the prospectus was issued, "A Miserable Investor" applied for a large number of shares, expecting to get, perhaps, one-tenth, and was surprised to receive an allotment of nearly three quarters of his application. We will let the correspondent tell the sequel of his story in his own words :—

> An hour or two after receiving the same I sent on to my stockbrokers to enquire value, and was informed they were at 10s. discount, meaning, of course, that that sum paid on application had been thrown away. I sent the next day: "15s. discount, and the market don't like them," was the reply; and to-day I have just come from the "House" where they are quoted 30s. discount "quite nominal."

"A Miserable investor" considers that "this state of affairs calls for immediate explanation." But what explanation can he expect will be forthcoming continues our contemporary. The transaction carries its own history on its face. It is perfectly true that no time was given for intending investors to inspect contracts, or anything else, for the prospectus announced that the list would close on the same day it was issued, "not later than 4 p.m." This, as we have before pointed out in many similar cases, is not right or fair, and instead of inducing investors to scramble for an allotment, should act beneficially as a deterrent. It is better to wait nine times out of ten, and purchase after allotment, than to run the risk of being merely a stag for persons more astute, or more in the know, than those who are not behind the scenes or in the promoter's confidence.

West Coast of America Telegraph Company.—Mr. Frederick Walters, of 12, Tokenhouse Yard, E.C., a partner of Messrs. Huth & Co. in Valparaiso, has been elected to a seat at the board of this company.

Patent Office Curiosities.—"Looker On," writing to *Industries*, says :—"It is generally supposed that America is the land of startling inventions, and it appears from the following that her reputation as such is being sustained. On referring to the specification of Allison's Patent No. 7805 of 1888, communicated from abroad by Charles Edgar Fritts, of New York, you will find a description of an electrical machine which, although small, will develop 670,241 H.P. There can be no doubt of the inventor's sincere belief in his machine, for the specification covers fifteen closely printed pages, and the description includes a mathematical proof of the theory involved. The principle of the invention is, as the inventor confesses, only an old one resuscitated, viz., to distribute currents of electricity by a series of condensers. Now, it will be remembered that this was one of the earliest methods which were suggested for the economical distribution and transformation of currents, and that it was ultimately abandoned because it involved the employment of condensers of inconveniently large dimensions for the transmission of currents of any profitable power. This is the crucial point of the inventor's new idea. He remarks : 'It is commonly supposed that in order to obtain a current of any considerable volume, a condenser of enormous size is required. My mathematical operations prove, however, that such is not the case. A condenser of 4 microfarads capacity charged at 2,000 volts will supply a 2 ampère current for $\frac{1}{250}$th of a second. Thus with a charging generator reversing 250 times a second, this tiny condenser will keep a 2 ampère alternating current flowing through 500 ohms resistance, and transmit over $2\frac{2}{3}$ H.P. in electrical energy. Or a 1 farad condenser, with the same speed of reversals and the same difference of potential with $\frac{1}{500}$ ohm resistance in the conductors, will keep an alternating current of 500,000 ampères and 1,000 volts flowing with electrical energy equivalent to 670,241 H.P., minus 1 per cent., or less, for loss in the condenser.' There are not many people who would be so particular about a loss of 1 per cent., or *less*, if they could obtain such a prodigious amount of work out of such a small machine. Does it not seem a pity that this carefully considered scheme for relegating the ordinary transformers into obscurity should have come to nought by a simple mistake in a matter of units?"

Galvanic Belt Quackery.—Mr. J. Jerritt writes (too late for our correspondence columns) : "It will be remembered that Mr. Parkes was recently threatened by the President of the British Association of Medical Electricians with immediate legal proceedings if he continued to pirate the word 'Electropathic,' which the worthy president said was specially coined for use of the Medical Battery Company, and which they claim as their registered trade mark. Mr. Parkes, in a circular just issued, states : 'I have no connection with any electric belts nor anything of the kind sold or styled by my name. Since my introduction many years ago of the descriptive title "electropathy" to my peculiar treatment, certain makers of so-called electric belts, of no electrical value whatever in the cure of disease, have styled their goods "electropathic." The use of this word applied to belts, &c., must not be confounded with "practical electropathy," which can be successfully carried out only by men thoroughly acquainted with the therapeutic uses of electricity.' An eminent lawyer, on being asked for his opinion as to the exclusive right of the Medical Battery Company to use the word 'electropathic,' writes :—'There is no right of property in a mere English adjective noun or word in common use, such as 'electropathic,' 'electropathy,' &c. The words 'electropathist' and electropathy were publicly used for years previous to the registration of the electropathic belt.' The eminent electrician, if ever he visits Plymouth, Exeter, or any of the large towns in the West of England, will find posted up in most of the electricians and philosophical instrument makers' shops a card with the following words :—'Zinc and copper discs for making electropathic belts. Price 1s. per dozen.'"

Modes of Capital Punishment.—Sir T. Robertson asked the Home Secretary last week whether his attention had been directed to a recent report addressed to the Governor of the State of New York as to the best mode of conducting the execution of criminals in that State; and whether he was prepared to recommend the adoption of either of the methods recommended in that report, viz., execution by electricity, or by the injection of morphia, or by the lethal chamber invented for the painless killing of the lower animals by Dr. B. W. Richardson, or of any other system of executing criminals more in accordance with the humane feelings of the present day than the barbarous and unscientific method now practised in this country. Mr. Matthews: No, Sir; my attention has not been called to this report, but I have seen a copy of an Act recently passed in the State of New York providing for the infliction of the death penalty by electricity. The Government are not prepared to introduce legislation with the view of altering the method of carrying out executions. I will, however, undertake to give careful consideration to the suggestions of my hon. friend.

Electric Lighting in the Tyrol.—The town of Innsbruck is to receive a central station on the transformer system. The plans, says *Industries*, have been elaborated by Messrs. Ganz & Co., of Budapest, and the work will be undertaken jointly by them and the local gas company. Power will be supplied by a mountain stream about 5 miles from the centre of the town, and as the water of the stream runs so rapidly that it does not freeze in winter, no reserve steam engine will be required. The current will be carried to the town by overhead conductors, and converted at certain points within the town by a few large transformers into a 100-volt current, which will be distributed by underground mains in the usual way. The plant will at first be laid down for the supply of 3,000 lamps, but it is expected that this number will ultimately be doubled.

Extension of Telegraphic Service in the North.—An important extension of the telegraph service in the north has just been completed, and others are in progress. Formerly Buckie and Banff were served by one wire to Aberdeen, but a new wire has now been erected to Banff, and was brought into use the other day for the first time. The same wire has been continued to Buckie direct, and serves the two offices. An additional wire has also been erected to Peterhead, and the Old Meldrum and Methlick service has also been improved. The Orkney traffic has hitherto been sent in the first place to Inverness, and thence retransmitted to Aberdeen or to Edinburgh as the case might be. Now, however, a new wire is in course of erection between Aberdeen and Kirkwall, and will be finished in the course of the month. At present there is a submarine cable to Lerwick, so that the Orkneys will now be directly connected with Aberdeen. Still another important work is the establishment of a new wire from Aberdeen to Newcastle direct, obviating delay by retransmission from Edinburgh. It is estimated that the cost of the improvements will not be less than £5,000.

Press Telegrams.—Mr. Cochrane-Baillie asked the Postmaster-General recently, whether, in view of the report of the Committee on the Revenue Departments, he could state that the Government would bring in further legislation to relieve the country from the loss incurred by the present agreement in connection with the sending of press telegrams. Mr. Raikes: I can assure the hon. member that I am quite in accord with the committee on the question of the transmission of messages on behalf of the press; but having regard to the fact that the charge rests upon the statutory powers conferred by the Telegraph Act of 1868, and that the charges levied have been in operation for upwards of 18 years, I fear that it would be difficult to make any change. The question of fresh legislation is, however, one more for the First Lord of the Treasury than for myself.

Electric Launches.—The continuation of the very able articles of Mr. Reckenzaun must, we think, form a theme of the greatest interest to our readers, and this week's contribution will be no exception. More information respecting the future of electric launches is here given in a brief form than we ever remember having previously seen.

Institution of Mechanical Engineers.—During the visit to Ireland of members of this body, an excursion was made to the Bessbrook and Newry electric tramway.

The Dangers of Alternating Currents.—In one of the many communications recently made to the New York Board of Electrical Control respecting the dangers of alternating currents, the writer says:—"Among the numerous *employés* of these [Westinghouse] stations, are living very many who have received direct from the generating machines, at the bare wires of the switchboards, the full intensity of this current. They received severe shocks, it is true, and the experience was not pleasant, but they were not killed. In most cases they continued at their work without interruption of more than an hour; they were not even made sick or nauseated." W. L. Wright made affidavit to the effect that he inadvertently took hold of a socket connected with a 1,000-volt alternating current circuit, with the result that he was thrown on to his face, and after awhile (still retaining his hold of the socket) became insensible. He soon recovered, and, beyond burns on the hands, suffered no ill effects. He felt sure that a direct current of that strength would have proved fatal.

The Microphone for Military Tactics.—The application of the microphone to military tactics has been on trial for some time at Montaubin, France. The instrument gives an automatic warning of the passage of troops along a probable line of march at a distance of many miles. A sounding plate is buried in the soil underneath an expected route of the enemy, and connection is made with an ordinary microphone at headquarters. Generals Vincendon and De Sonis, with their staff, were present at the experiments, and they were sufficiently impressed with the practical utility of the apparatus that a report was sent to the Minister of War. Orders have since been received by the inventor to continue his experiments under official superintendence and technical advice.

Telegraphic Extension in Lewis.—At a meeting of the Police Commissioners of the burgh of Stornoway last week, it was stated that the Lords of the Treasury had agreed to establish telegraph stations at Port of Ness, Portnaguran, formerly Baybole, and Gress. A letter from the secretary of Lloyd's Committee was read, agreeing to grant £20 annually towards the seven years' guarantee of the telegraphic extension to the Butt of Lewis. It was resolved to memorialise the Fishery Board to open sub-telegraphic offices at Garaboot and Barvas, and to extend the telegraph from Barvas to Carloway, an important fishing district. Telegraphic communication has now been opened with Portnaguran, a fishing port thirteen miles distant from Stornoway.

The Telautograph.—A *Daily News* telegram from New York announces that an immediate effort is to be made to apply Prof. Gray's new invention, the telautograph, to commercial uses. The Judge of the Circuit Court of Richmond, Virginia, has just granted a charter for the purpose of working the invention. The capital of the company is not to be less than $500,000, nor more than $15,000,000, divided into shares of $100 each. The company may hold 10,000 acres of land in each of the States and Territories. The principal office will be in Richmond, with branch offices where needed. As soon as $600,000 are subscribed the company will commence business. Some of the largest capitalists in the country are said to be interested in the enterprise.

Electric Railway on the Bürgenstock.—From Thun, under date August 6th, a correspondent of the *Lancet* writes:—"Among the many favourite resorts on the Lake of Lucerne at which the holiday maker can enjoy the pure air, the delicious quiet, and the exhilirating scenery of the Alps, the Bürgenstock has long held a prominent place. The hour and a half consumed between Stans-stad, the station on the lake, and the hotel on the Bürgenstock used to be felt as the most wearisome out of the twenty-four from the starting point in London; but now that one drawback to the pleasure has been removed. On the 8th inst. was opened the electric funicular railway, which begins just at the base of the mountain at Kehrüten, the new landing place; and in a few minutes, at the cost of one franc, the traveller will find himself transported, as pleasantly as in a balloon, to the hospitable portals of the Bürgenstock Hotel. The old tedious journey round by Stansstad and up the mountain side—the latter stage of it costing from 10 to 20 francs—is now a thing of the past; and even those who do not intend to make a sojourn on the Bürgenstock, but who would not like to miss the glorious aspect it commands, can, from Lucerne, reach the hotel by lake and electric railway in the forenoon, ascend to the Hanztschwand or summit, and enjoy the view of the lake and its sisters, the Sarnen, Sempach, Baldegg, Hallwyl, and Zug, and of the peaks of the Rigi, Pilatus, Mythen, Wiessenstein, and the Alps of Glarus and Unterwalden, with part of the Bernese Oberland, returning to Lucerne in time to catch the Milan express, which reaches Basle in the evening. The swift flowing Aa, at Buochs, supplies with its 150 horse-power the force required for the railway, as well as for the electric illumination of the hotel."

City and Guilds Institute Examinations.—The report of the tenth examination in technology under the direction of the City and Guilds of London Institute, states that the number of candidates examined was 6,166, against 5,508 in 1887; 3,510 passed. The percentage of failures in the several branches of electrical engineering showed an increase. In Electro-Metallurgy there were 19 candidates, one gained a first, and two seconds in honours, five were first, and three second in the ordinary class; in all, 11 passed and 8 failed. In Telegraphy 115 were examined, 16 passed first, 14 second, and 11 failed in honours, 13 first, 27 second, and 34 failed in the ordinary class; 70 passed and 45 failed. In Electric Lighting 198 were examined, seven passed first, 15 second, and 24 failed in honours, and in the ordinary class 46 were first, 52 second, and 54 failed; 120 passed and 78 failed. In Electric Instrument Making, 14 were examined, three were first, and one second in honours, none failing, two were first, five second, and three failed in the ordinary class; 11 passed and three failed.

Workmen's Outing.—Last week the workpeople of Messrs. Elwell-Parker, Limited, of Wolverhampton, to the number of over 200, had their annual excursion, the place selected being Bridgenorth. The various places of interest were visited, and about one o'clock the party repaired to the Commercial Inn, where an excellent dinner was provided. Mr. J. Westwood proposed "The Firm," and said there was a large increase in the number present, and a comparison with former occasions showed a striking proof of the progress which, year by year, their firm was making. Mr. T. Parker, in responding for the firm, said the confidence of the people in electricity was being regained, and it needed no prophet to see that the beginning of the prosperous days of electricity were not far distant. As for their firm, they had only known prosperous days. Their difficulty had been that of having more business than the capacity of their works enabled them to do.

Not to be Trifled With.—The following story illustrates one of the adventures which electric light companies employés sometimes experience: Mrs. Elizabeth Kinney lives at the corner of Marshall and Slater Streets, Paterson, N.J. One morning men appeared and made preparations to erect an electric light pole in front of her house. She remonstrated with them, and told them that they had not permission, but they paid no attention to her. Just as the pole was about to be raised, Mrs. Kinney came out of her house and calmly stood over the hole that had been dug. "John," she cried, calling to her husband, "bring me a shovel." John did as she told him, and, to the astonishment of the linemen, she began to fill in the hole. After she had thrown in a few shovelfuls, she called her husband. "John" she said, "you fill up the hole and I will pay you for it." She is the owner of the house. John responded and completed the work of filling up the hole. The electric light men then picked up the pole and took it to the other corner, where they planted it. Mrs. Kinney is the heroine of the neighbourhood.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Gülcher (New) Electric Light and Power Company, Limited.—An agreement of 30th ult., provides that the assets of the old, other than cash in hands of the liquidators, be transferred to this company freed and discharged from all claims of the debenture holders of the old company. The consideration is £16,000 in cash and the allotment of 20,000 fully paid ordinary shares of £1 each.

Anglo-Portuguese Telephone Company, Limited.—An agreement of 8th inst., filed on the 14th inst., between the company of one part and Sir Alexander Armstrong and Richard Van Zeller of the other part, cites that the company is about to issue a series of debentures not exceeding £10,000, exchangeable at holders' option for fully paid ordinary shares of an equivalent nominal amount.

Series Electrical Traction Syndicate, Limited.—The statutory return of this company is made up to June 12th. The nominal capital is £30,000 divided into 5,000 preference, 5,000 "A" and 20,000 "B" shares of £1 each, the latter being considered as fully paid up. Upon 5,000 preference shares 15s. per share has been called, and upon 200 "A" shares a call of 2s. per share has been made. The calls paid amount to £3,280, and unpaid to £490. Registered office, 11, Queen Victoria Street.

Self-Winding and Synchronising Clock Company, Limited.—An agreement of 11th June, filed on the 2nd ult., between Chester Henry Pond, of Brooklyn, New York, electrician, of one part, and the company of the other, states that under a provisional agreement, dated 17th May, 1886, Mr. Pond became entitled to 3,000 ordinary shares in the company, and also to £2,000 in cash by payment to him of one half of all amounts received by the company in respect of shares allotted and paid up in cash in excess of the nominal amount of £8,000 until the said sum of £2,000 shall have been paid to him. The company has recently arranged with Mr. Pond to surrender the said 3,000 shares, and also to release his claim to the said sum of £2,000 in consideration of his receiving from the company 800 seven per cent. cumulative preference shares of £1 each, credited as fully paid up.

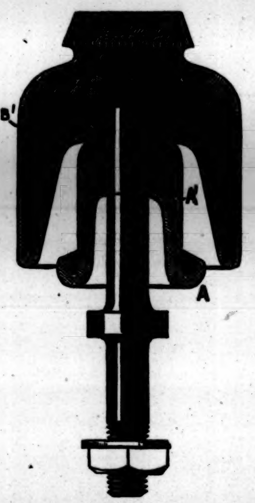
Electrical Works Construction and Maintenance Company, Limited.—The registered office of this company is now situated at 19, Great Winchester Street. W. Cleland Heywood, secretary (*pro tem.*)

Metropolitan Electric Supply Company, Limited.—The office of this company is removed from 169, Winchester House, to 307, Winchester House, Old Broad Street.

General Zinc Recovery and Lighting Company, Limited.—The registered office of this company is now situate at 2, Moorgate Street Buildings, 20, Moorgate Street.

AN IMPROVED INSULATOR.

AN improved description of insulator has recently been patented by Messrs. W. E. Langdon, J. C. Fuller and G. Fuller. The inventors turn up the bottom or lower end of the inner tube or cup, A^1, of the insulator, as at fig. 1, so as to form a cup or receptacle, A, at or near the base, or they form a groove in the lower edge of the outer tube or cup, B^1, or in some cases both the inner tube or cup, A^1, and the outer tube or cup, B^1, may be formed with receptacles.



In the cups or receptacles melted paraffin wax or other insulating material is poured, which hardens in its place, and the exposed surface of such insulating material can afterwards, when required, be wiped clean from time to time.

By the use of these cups or receptacles containing a ring or rings of insulating material, it is claimed that a very perfect insulation between the wire and bolt is obtained.

THE TESTING OF ELECTRICAL INSTRUMENTS.

AN announcement in regard to the testing of electrical instruments and apparatus in the Physical Laboratory of the Johns Hopkins University has recently been issued. The announcement states :—"In order to bring electrical measurements to a greater uniformity and accuracy it has been decided to undertake at this University the comparison of electrical instruments and resistances, together with such tests as cannot be made without special or elaborate apparatus with which private individuals are not usually provided."

There can be no doubt but that a laboratory which will undertake work of this kind is a crying want, in this country at least, and it is hardly a creditable fact that we in England should practically have made no move towards providing means for verifying the correctness of electrical measuring instruments, resistances, &c., although we feel sure that the fees would be readily paid for such verifications, and would amount to a very fair yearly sum. Something more than a mere notification by any small manufacturer that he will be prepared to verify the correctness of any particular instrument for a stated fee would, however, be required. Absolute confidence that the offered verification will be reliable must exist, and this can only be the case if the work is carried out in a laboratory where it is known that proper appliances are provided regardless of cost, and where really skilled assistants are employed. Such a laboratory now appears to have been arranged at the Johns Hopkins University, the requisite instruments for making really accurate measurements of all kinds and of all grades being provided. The prices to be charged are as follows :—

Current meters (according to range)	...	$5 00	to	$7 50
Voltmeters „ „	...	5 00	„	7 50
Resistance boxes „ „	...	5 00	„	25 00
Standard resistance coils... ...	...	5 00		
Condensers	...	5 00		
Curve of magnetisation	...	10 00		
Constants of batteries, insulators		According to nature of test.		
Efficiency of dynamos, motors	...			
Spiral work, calculations, &c.	...			
Alternating current apparatus	...			

We hope that the example of our American friends may lead to something being done in this country.

AMERICAN NOTES.

By DAS TELEPHON.

PROF. ELISHA GRAY, who was the first person to file in the U.S. Patent Office a full description of a method and of an apparatus for the reproduction of speech by means of electricity, has obtained a patent, dated July 31st, 1888, for a combination of instruments called by him the "*telautograph,*" consisting of a transmitter and a receiver, and designed for transmitting messages by wire between distant points by the sender in his own handwriting. A company with a capital of only fifteen millions of dollars has been formed to exploit this latest invention of Prof. Gray, together with his telephone and telegraph inventions.

The civil authorities of many of our cities are having a lively time with the telegraph, telephone, and electric light companies about overhead and underground wires. The authorities of States and cities have, in the abundance of their scientific acquirements, decided that there shall not be any wires overhead in cities, and that the wires shall be underground; this latter decision is doubtless a great boon to the various companies, because the decision carries necessarily with it the total abolition of induction between neighbouring wires, and also of retardation, much to the satisfaction of the scientific world, which has for years been trying to diminish these evils. Legislators, however, seem to know more of the unknown actions of the electric current than those scientific men who have grown gray in their investigations of the subtle fluid. When these scientific legislators have disclosed their great discovery of the means they have invented to prevent the powerful current of an electric light dynamo from producing any effect in the neighbouring wire used for telephonic purposes, your REVIEW shall be the first to be informed of it by cable.

The strongest argument against overhead wires is the death-dealing qualities of the electric current of the dynamos used for electric lighting. A controversy is going on about this matter, and experiments are being made to prove and disprove the deadly qualities of the dynamo current.

A successful telephone company in Baltimore using of necessity the Bell instruments, has just completed a handsome new building, five stories high, 100 feet by 27 feet, of pressed brick with granite and brown stone facings, and is considered to be fire proof. This company has 2,300 subscribers in this city of 400,000 inhabitants. This company proposes to put some of its wires underground. On this subject the Mayor of Baltimore expressed himself as follows :—

"With the new building will doubtless come the next great improvement—putting the telephone wires underground. While this is most desirable, and would be a public benefit in many respects, it should not be forgotten that it has become a necessity for the telephone company, in order to give its constantly increasing number of customers proper facilities. To put the wires underground requires digging up the streets. This is a public inconvenience at all times. No city has suffered from it oftener than Baltimore. We have gone through the annoyance of five or six opposition gas companies. I think the telephone company should pay to the city an annual sum for the use of its streets. It may be said that no other city has charged anything for this franchise, but then no other city charges the passenger railway companies anything, while Baltimore derives an annual revenue from this source of nearly $150,000. The State Legislature has given away the franchise of our streets to the gas companies and to the telegraph posts. The city should not be induced by the desirability of underground telegraph, telephone and electric light wires to give away the valuable franchise of putting conduits underground. This is rapidly being recognised as a necessity by these companies, and they can make it very profitable. The city should get a revenue therefrom, and thus somewhat relieve our already overburdened taxpayers."

ON THE EFFECT OF OCCLUDED GASES ON THE THERMO-ELECTRIC PROPERTIES OF BODIES, AND ON THEIR RESISTANCES; ALSO ON THE THERMO-ELECTRIC AND OTHER PROPERTIES OF GRAPHITE AND CARBON.*

By JAMES MONCKMAN, D.Sc.

AFTER some preliminary experiments two wires of palladium were used as the electrodes in decomposing acidulated water, dried and gently heated in contact, a current towards the hydrogen was then observed. Arc lamp carbon rods were next tried. They were heated to a red heat to expel gases, and the ends were filed flat. It was found that when one of these rods was heated and placed against the other, the current was always from cold to hot below 200° C. They were then used as the electrodes in decomposing dilute sulphuric acid, dried carefully until no current was produced on placing them in contact. On heating either rod and joining them as before, a current was produced from hydrogen to oxygen across the hot junction.

The same effect was obtained by decomposing hydrochloric acid solution, in which case we get chlorine instead of oxygen, and the current flows from hydrogen to chlorine.

If the rod be saturated with SO_2 it is found to act like those containing oxygen or chlorine.

Resistance.—In the first experiments made to try if any change of resistance took place when wires are saturated with gas, a platinum wire about a yard in length was formed into a spiral, and each end soldered to an insulated copper wire. The junctions were covered with wax, and the wires, carefully insulated with wax, passed through two holes in a cork into a bottle containing dilute sulphuric acid. Through the same cork there passed a thermometer and two glass tubes. The whole was placed in a large vessel of water. After having saturated the wire with hydrogen, the acid was drawn off, and air drawn through for some time. The resistance was found to increase slightly on testing.

To get rid of possible error from change of temperature, two wires of equal length and section were used and balanced against each other.

These were placed in water, and a current passed from the one to the other, allowed to remain in the acid a little to cool if necessary, and afterwards removed, dried, and placed in an empty glass vessel surrounded with a considerable quantity of water. There they rested until the temperature became the same as the water. When measured the resistance of the wire containing the hydrogen was found to have increased about one-thousandth part. It is not necessary to try the effect of hydrogen on palladium, as the resistance is known to be increased considerably by the absorbed gas.

Carbon.—Two thin rods about 2 mm. diameter were electroplated at the ends and soldered to insulated copper wires. After protecting the plated portion with marine glue, the whole was fixed to a convenient frame and placed in dilute sulphuric acid. As was done in the case of the platinum wires, the rods were balanced against each other in order to eliminate changes of temperature, &c.

When used as the poles of a battery the change of resistance was considerable, but greater on the rod that had been the positive pole. By using a platinum electrode, hydrogen or oxygen was produced at will upon the same rod, the other rod remaining unchanged. It then appeared that oxygen increased the resistance much more than hydrogen, rising in some cases as high as nine times; that when oxygen was liberated twice or thrice in succession, the resistance increased each time. This continued increase was probably due to chemical changes produced by the active oxygen. Hydrogen gave a small increase of resistance, not continuing beyond a certain point, and not becoming greater on repeated charging with the gas.

Generally also the effect of the hydrogen was temporary, disappearing, wholly in some cases, partially in others, when short circuited.

Superposition of Polarisations.—Part of the change in the carbon is evidently produced by the mechanical action of the gases evolved, and by the chemical action of the oxygen; both of these will, however, produce permanent changes. That only part of the action is to be explained in this way is shown by the previous experiments. It is, however, further demonstrated by using two carbon rods in decomposing acidulated water; after passing the current for one minnte, reverse it for one-tenth of a second, and immediately join up to a galvanometer. A short but violent deflection appears for the latter contact, gradually falling to zero and passing to the other side, where it remains for a considerable time, though with much decreased quantity.

The same thing was obtained with platinum electrodes. The second contact must be very short, or the former polarisation disappears. I have not yet succeeded in obtaining more than one reversal, although I have no doubt that more may be got with very thick electrodes.

Resistance.—Copper and iron absorb hydrogen and silver occludes oxygen, but no change in their thermo-electric properties could be detected. Carbonic oxide is absorbed by iron, and is said to produce great changes in its properties. In this case, however, only the resistance was measured.

A piece of iron wire, about 3 yards in length, was twisted into a spiral and placed in a porcelain tube; the ends, projecting about 3 inches, were connected with one side of a bridge and balanced against an equal spiral of the same wire. After exhausting the tube, about 1 foot of the central portion was heated to a bright redness and then allowed to cool. Next day the resistance was measured, and the experiment repeated twice. On the third heating, carbonic oxide was allowed to enter the porcelain tube, and readings of the resistance taken on cooling as before. This was also repeated.

This series was again repeated with new wires, and, lastly, the wire was raised to a bright red *in vacuo* and allowed to cool, the object being to remove the carbonic oxide gas in order that another measurement might be taken after these repeated heatings. The resistance fell, clearly proving that part of the previous increase was due to the presence of the gas. No measurement of resistance was taken on the same day that the wires were heated, but at least 15 hours were allowed to elapse.

First series of observations give the numbers thus:—

Average of three measurements after heating *in vacuo*	0·4	ohm.
Average of three measurements after heating in carbonic oxide	0·41	„
With the new wire—		
Average of three measurements after heating *in vacuo*	0·63	„
Average of three measurements after heating in carbonic oxide	0·655	„
After heating *in vacuo* to expel the gas, it fell to ...	0·642	„

These experiments appear to prove that absorbed gases increase the resistance of conductors, and that hydrogen renders metals more negative (thermo-electrically) whilst carbon becomes more positive.

Thermo-electric and other Properties of Graphite and Carbon.

Near one end of a carbon rod a hole, about 5 mm. in diameter, was drilled, and into this thre end of a platinum wire was inserted and fixed by being wedged with a piece of rod carbon. The whole was thoroughly covered with Indian ink, which, when dry, was again covered with clay. The carbon rod was insulated from the platinum wires, and they from each other by thin sheet asbestos and mica, by which means it was insulated from the vessel in which it was placed, and luted with clay to prevent access of air. The numbers obtained in three series are—

Expt. 1.		Expt. 2.		Expt. 3.	
t°.	E. in micro-volts.	t°.	E.	t°.	E.
50	270	220	1800	210	1620
70	450	344	3240	312	3024
88	540	499	5760	471	5292
107	720	620	7560	685	8154
130	900	700	9900	722	9990
160	1260				
180	1440				
210	1620				

The colder junction was 17° C.

The resistance of the Pt-C couple was found to vary, increasing to 600°, after which it decreased. This result being caused by the increased resistance of the platinum being partly neutralised by the diminution of the resistance of the carbon, to which must be added the improved contact obtained by the expansion of the platinum in the carbon, which is greater than the expansion of the carbon, thence the pressure increases and the contact improves.

The numbers were at 220° C. 0·88 ohm, 340° to 500° C. 0·92 ohm, 620° C. 1·03, 700° C. 1·00.

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[*] Abstract of paper read before the Royal Society.

ILFRACOMBE AND THE ELECTRIC LIGHT.

AT a recent special meeting of the Ilfracombe Local Board the chief business was a motion of which Mr. RUSSELL had given notice with reference to lighting the town with the electric light.

Mr. RUSSELL said he hoped and felt sure that the board would give the consideration which was due to a matter which was so important, and which affected the whole town. As regarded the cost, as far as they could at present ascertain from the offers made, the difference between the electric light and gas was about £50. The offer for lighting the whole town was £680, against £630 for gas, and the light from electricity would be about three times the quantity as that from gas. The question was whether or not the electric light was worth the £50 extra, assuming that they received no lower tender than the £680. He thought that £50 on such an amount as £680 was a very trifling matter, when they considered the very great advantages of the electric light. Let them take the tradesmen who would be interested in getting the electric light into their premises. He himself knew what that would mean to them. They must all do an amount of business by artificial light not only in the winter, but they all carried on a great deal of business with artificial light in hot weather; and the electric light would be a great advantage both to the tradesmen and assistants. To work by gaslight was exceedingly hard and trying indeed. He believed it was of great consequence to every business man in the town and to his *employés* as to whether they would have a number of gas burners going or whether they would have the electric light. The latter did not render the room more oppressive than if they had the ordinary daylight, but with gas it was exceedingly unhealthy and oppressive, and the two or three hours they kept open their shops after the gas was lit, tried them more than all the rest of the day. If the board had the electric light throughout the town it would enable the tradesmen to take it into their business premises.

Mr. **Thomas** asked if Mr. Russell had any idea of how many would take it in.

Mr. **Russell** thought several would. With regard to the Victoria Promenade, if they lit that with gas all the plants would be killed, and if it was their intention so to do he hoped they would not plant it. If they lit the town with the electric light they would get three times the illuminating power, so that it would enable them in many cases hereafter, as the town extends, to take lamps out here and there—certainly in future they would be able to have them farther apart, in sufficiently straight streets. Therefore he thought the probability was the lighting bill need not be increased by £50 by having the electric light. If they advertised for tenders they might get it done cheaper. He then moved, "That the board give the gas company six months' notice that they will not require their gas for the public lamps after Lady-day next; and that tenders be invited for lighting the whole town with the electric light."

The **Surveyor** remarked that every firm had been asked to give a price for lighting the whole town with the electric light.

Mr. **Russell** said he understood they had not.

Mr. **Gould**: It was not stated in the advertisement, but they have been asked by letter.

The **Chairman** said that would not do,

Mr. **Russell** said they would have to invite tenders again.

Mr. **Camp** said he had heard nothing about the cost of laying down the mains; was it included in the £680?

The **Surveyor** said it would not be right to invite tenders, seeing that Mr. Woodley had offered to light the Shelter at a low rate in view of having the contract of lighting the whole town.

Mr. **Thorold** said they were not bound to consider what was in Mr. Woodley's mind.

The **Chairman** said they told Mr. Woodley they could not consider the question of lighting the whole town.

Mr. **Russell** was prepared to move that the offer of Mr. Woodley be accepted.

The **Chairman**: You cannot do that by the wording of that advertisement.

Mr. **Baker** said it would not be wise for them to throw up their contract with the persons who were at present supplying them with light before they were certain that the electric light was available, and that it would suit the pockets of the ratepayers. Where should they be supposing the gas company cut off their gas and the board had not got the electric light?

The **Chairman**: We should light it with oil lamps like other towns have done.

Mr. **Day** said that Mr. Russell stated that gas would kill the plants, but Mr. Lake and other members had frequently said that if lit with prepared gas burners it would not kill the plants. As to inviting tenders for lighting the town he approved of that principle, and thought it would give the Gas Company an opportunity to compete with the electric light. He believed it could be easily shown that the Gas Company were prepared to light the town for less money than the board were now paying.

The **Chairman** said the discussion must narrow itself down to the one point—whether they should give the Gas Company notice or not.

Mr. **Russell** (to the Chairman): Have you any offer from the Gas Company that they are willing to reduce their price for lighting the town.

The **Chairman** said a letter came from the Gas Company offering to light the Shelter for less money, but nothing was said about lighting the whole town.

Mr. **Day** expressed a belief that they soon would have such an offer.

Mr. **Russell**: If you have anything from the Gas Company to put before us let us consider it. (To the Chairman): Do you rule that we cannot accept this offer of Mr. Woodley's yet?

The **Chairman**: I certainly think we cannot, and I believe the members will bear me out in that.

With reference to lighting the Victoria Promenade, the **Surveyor** said that in answer to Mr. Woodley's letter in which he said he thought the board ought to pay for the gas for the engine, he sent him a telegram saying that the board absolutely declined to do so. In reply to that he had received a wire "I accept contract for eight months and pay gas."

The **Surveyor** said it seemed to have got into Mr. Woodley's mind that they would not require the building lit for the whole 12 months, and when he (the Surveyor) asked him if he would make any reduction for the eight months, he stated that he had already done so.

Mr. **Thorold**: We pay £150 a year for eight months' lighting; therefore I don't see the enormous advantage—I think it is very costly.

The **Chairman**: Mr. Woodley is free. There is no contract with him now.

Mr. **Day** said that would amount to about £60 a year against £150 for electricity.

A letter from the Gas Company was read, offering to light the Victoria Promenade with 10 Wenham gas lamps, at a cost not exceeding £50 for the lamps and fittings and 3s. 9d. per 1,000 feet for the gas.

Mr. **Russell**, instead of proposing his original resolution, moved that tenders be invited for lighting the town with electric light, also the Promenade and Parade, the candle-power in the streets to be 32 to 50, 3,000 in the Promenade, and 50 in the Parade lamps. They should invite the tenders forthwith so as to be in time to give the gas company notice at Michaelmas.

Mr. **Thomas** seconded Mr. Russell's motion.

Mr. **Day** moved as an amendment: "That tenders be invited for lighting the town and public buildings." He did not see why they should restrict themselves to tenders for lighting with electric light; let them have a fair competition.

Mr. **Thorold** seconded. He thought the electric light might be applicable to towns where they had straight streets, but did not think it would answer in Ilfracombe where they had so many passages. They could not afford to take electric light into all these passages, and would have to burn gas in some of them.

Mr. Day's amendment was put and carried unanimously, Mr. **Russell** expressing himself as quite willing to vote for it, on condition that the candle-power invited would be the same in each case. It was understood that this would be done.

It was then resolved "that notice be given at Michaelmas next to terminate the contract with the gas company;" also "that the surveyor be instructed to make arrangements for temporarily lighting the Victoria Promenade, in case of necessity, and also to appoint a temporary caretaker.

EASTBOURNE AND THE ELECTRIC LIGHT.

At the last meeting of the Eastbourne Town Council, Alderman **Morrison**, referring to the notice given by the Electric Light Company to terminate their contract unless the cost of the light was raised from £25 per lamp to £35 per lamp, said that the Committee had had an interview with Mr. Routledge, Mr. Lowrie, and Mr. H. Towner, and they went into the question very fully. It was only fair to say that Mr. Routledge on behalf of the Company expressed the thanks of the Company to the Corporation for the kind manner in which they had treated them in the past. When the report of the Committee was drawn up, he (Alderman Morrison) thought it right to ask the Town Clerk to send a copy of it to the Electric Light Company so as to show them what it was intended to bring before the Council. Mr. Routledge had sent back a letter in reply, saying that the only suggestions he would make were that it should be inserted in the report that the cost of each lamp to the Company had been £33 per annum. Also that the reason why the Company wished to have a five years' contract was because of the expense that would be entailed in laying down the light on the Royal Parade. The Committee had not made any recommendation as they thought because only three were present when the report was drawn up, and as the matter was of such public importance, it would be better to leave it in the hands of the Council.

Councillor **Chambers** said that having taken a great deal of interest in this question of electric lighting and believing it was one which had a very important bearing on the credit and character of the town, he confessed that he had read with great regret the possibility of being obliged to take what must certainly be described as a retrograde step. He believed himself that the fact that they had employed electricity for the town had helped to develop it and had done a great deal of good. On that ground he should regret their being obliged to retrace their steps. It seemed to him that rather than lose the advantage of the electric light on the parade it would be worth while, if they felt unable to face the cost of £35 per lamp, to know whether they could make terms on the question of fewer hours. This question did not appear to have been gone into. He saw it stated that the Hastings lamps only cost £30. He was under the impression that the Electric Light Company had offered to supply at the same price as that in other neighbouring watering places. He moved as an amendment that the offer should be made to the Company to take £30 per lamp, provided they were only kept burning till eleven o'clock.

Councillor **Francis** thought if they lost the electric light they would lose the great effect of the parade by night. He should be sorry to see the light done away with. He would second the motion.

Councillor **Cunningham** quite endorsed what had been said in favour of electricity, and thought that they might even stretch a point if necessary.

Councillor **Mitchell** also endorsed what had been said as to the electric light. He would be very sorry to see it done away with, but considering the great expense of the light he could not see his way to consenting to extend it to the Royal Parade.

Councillor **Pearce** said that the Committee had no idea of discontinuing the electric light. With regard to the Royal Parade it was not necessary to have it there, but he thought it very essential that it should be kept on the Grand Parade.

On Councillor Chambers's motion being put it was carried unanimously.

Councillor **Mitchell**, referring to the offer of the Electric Light Company to light the shelters with electricity at 1s. per unit of force, moved that they should be asked to name some definite sum for which they would light the whole of the shelters.

Councillor **Chambers** said that was not a convenient form in which to put the amendment. He would move that they be asked to say so much per shelter, or so much per light.

Councillor **Martin** seconded the proposition of Councillor Chambers.

Councillor **Francis** proposed that the shelters should be lit at once with gas.

Councillor **Lawrence** seconded the motion. He did not see of what use electricity would be there.

Councillor Francis's motion was put and carried.

ON SOME EARLY FORMS OF ELECTRIC FURNACES.*

By Prof. EDWIN J. HOUSTON.

Siemens's Electric Furnace or Crucible.

In 1879, Charles William Siemens took out letters patent in Great Britain for "Improved Means and Apparatus for Producing Light and Heat by Electricity." This patent is numbered 2,110 of 1879. The completed specification is dated November 26th, 1879.

The matter contained in this patent is, to some extent, an application of the principle described in a prior patent, No. 4,208 of 1878, to the same inventor. This principle consists briefly in cooling one of the electrodes of an electric source by means of a stream of water forced through a cavity in the same.

Siemens applies this principle to the utilisation of the direct heat of the voltaic arc for the heating of a crucible, in which furnace operations that require great heat may be conveniently carried on.

The following general description of this process is taken from the provisional specification, viz.:

"In applying the electric current to the production of intense heat for the fusion of refractory substances, I employ two carbon rods, fitted to slide towards each other horizontally, within water-cased tubes, which are attached to the opposite sides of a crucible made of highly refractory material, such as lime or alumina, also water-cased if necessary. The substance to be fused is introduced into the crucible, and the carbon rods are advanced sufficiently near to each other to form the voltaic arc within the crucible. The clockwork which advances them has a flyer which can be retarded or arrested by a break or stop connected to a thin metal strip which forms a part of the electric circuit, or to the armature of an electro-magnet, the coil of which forms part of the circuit. As the heat in the crucible increases, the resistance to the voltaic arc within it diminishes, and consequently the arc can be elongated, a result which results from the automatic retardation or stoppage of the feeding clockwork. The crucible may be closed by a cover having apertures through which air or other gases may be blown or drawn to act on the substance under treatment. In some cases, instead of employing carbon for the terminals, they may be made of the material that is to be fused, when it has sufficient conductivity."

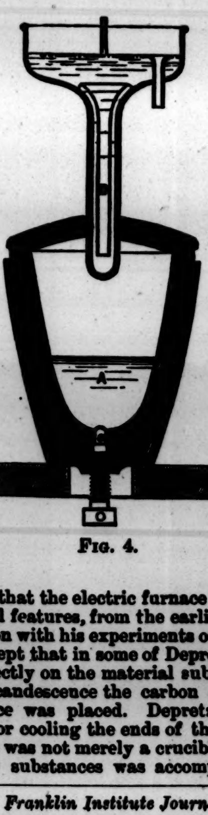

Fig. 4.

It will be noticed that the electric furnace of Siemens does not differ, in its essential features, from the earlier forms described by Depretz in connection with his experiments on the fusion of refractory substances, except that in some of Depretz's forms the voltaic arc did not play directly on the material subjected to fusion, but heated to intense incandescence the carbon crucible or vessel in which said substance was placed. Depretz's furnace, however, provided no means for cooling the ends of the electrodes.

Siemens's furnace was not merely a crucible in which the fusion of highly refractory substances was accomplished. The hollow carbons, or the perforated cover, provided for the introduction of air or other gas, clearly shows that he contemplated the carrying on of what might properly be classed as furnace operations, or reductions, under the influence of the high temperature of the voltaic arc.

The forms of electric crucibles devised by Siemens will be best understood from the following description taken from the completed specifications, viz.: "Fig. 4 shows apparatus according to my invention for applying the heat of the voltaic arc within a crucible." . . . . . . "I have shown in the figure one of the terminals, A, to be a carbon, and the other, B, as a metal pole cooled by circulation of water as described in the specification above referred to. Both terminals might, however, be carbons, and both or either might be tubular, as shown with respect to A, so that currents of air or other gas might be sent through them into the crucible for effecting chemical reactions therein. The terminals rest on grooved rollers, R, R, being pressed down thereon by heavy rollers, *r*, *r*." . . . .

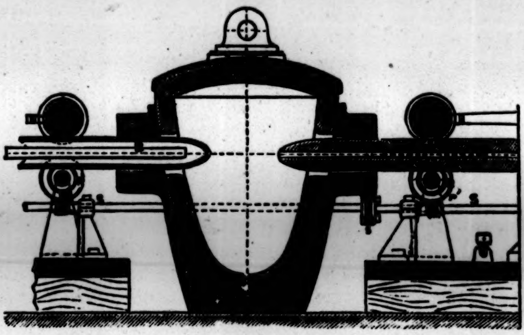

Fig. 5.

"When the material treated in the crucible is a conductor, the arrangement shown in fig. 5 may be adopted. In this connection material, A, such as fused metal forming the one terminal, lies in the bottom of the crucible in contact with a screw or pin, *a*, faced with the platinum or other metal that will not be acted on by the material, A The other terminal, B, which is cooled by the passage of water through it, as described in the specification above referred to, is suspended through a hole in the crucible cover, and it can be made to ascend or descend as required for regulating the distance between the terminals, by the action of a solenoid or expanding metal wire or strip as described above with reference to the carbons of electric lamps."

In the operation of this crucible it was found that there was a tendency of the voltaic arc to pass to the walls of the crucible, rather than to the substance subjected to the heat. This tendency was, to a great extent, checked by surrounding the outside of the crucible with a coil of wire.

Some experiments conducted with this crucible by Dr. Siemens and Prof. Huntington are recorded in a paper read by them at the fifty-second meeting of the British Association for the Advancement of Science, held in August, 1882.

The following abstract of some of the more interesting of these experiments is here given.

The current employed, which was of from 250 to 300 ampères, was obtained from five dynamo-electric machines, four of which were coupled together, and the other was employed as an exciter.

A number of difficult fusions were effected, viz.:

(1) Six pounds of wrought iron were kept in the heat of the arc for twenty minutes, and then poured into a mould. The cooled metal was found to be crystalline, and to no longer possess the ability to be wrought.

(2) Twenty pounds of steel were completely melted in one hour in a single charge.

(3) Three-fourths of a pound of copper, placed in carbon dust, were melted in half-an-hour—only three-fourths of an ounce, however, was found remaining in the retort. The rest had been vaporised!

(4) One-quarter of an hour was sufficient to reduce eight pounds of platinum to the liquid state.

(5) Some curious results are noticed both during the fusion and vaporisation of tungsten, and in the properties of the product as found in the electric crucible.

The electric crucible, as constructed by Dr. Siemens, must be regarded as admirably suited for investigation on the fusion of refractory substances.

Central High School, Philadelphia, *April 5th*, 1888.

The "Great Eastern."—Nearly the whole of the machinery and ironwork has been removed from the *Great Eastern*, and on Tuesday she left the Clyde for Barrow to be broken up. It is a pity (writes a correspondent) that she could not be secured and towed inland into some river or arm of the sea and there fitted up as a hospital or home of rest for disabled seamen, as her iron walls are still in excellent condition.

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* *Franklin Institute Journal.*

AN INTERESTING DYNAMO.

ONE of the neatest pieces of electrical apparatus which we have seen for some time, says *Modern Light and Heat*, is a small alternating current dynamo, built by Messrs. Fred M. Kimball & Co., Boston, for Prof. A. E. Dolbear's physical laboratory, Tuft's College, Somerville, Mass. This little dynamo, which externally looks much like the Siemens alternate current machine, is designed to deliver one ampère at a pressure of 1,000 volts when run at 2,500 revolutions per minute. So carefully balanced is its armature that while running at the above speed—the machine simply standing on the floor without being bolted down—we could not discover any perceptible tremble or tendency to move about. One of the peculiarities of this machine is that its current changes direction no less than 60,000 times per minute, which is much more rapid than any machine we have ever heard of. Being aware of this fact, we were somewhat surprised to find that while running it emitted a very pleasant and not very high musical note. Now if the machine had been vibrating in unison with its current alternations, it would have given off a note not far from four octaves above the middle C of a piano, which would have been so shrill and high as to be scarcely audible, while on the contrary, as above stated, it was a not very high and rather soft note. Thinking that perhaps the note we heard had nothing to do with the electrical alternations of the machine, we attached a telephone receiver to a coil of wire placed near the armature of the dynamo, when we heard through the telephone the same soft, musical note, showing that the machine was incapable of vibrating as rapidly as the change of direction of the current in its coils, and was vibrating probably in a harmonic, an overtone, or if we may so call it in this case an *undertone*, of the machine's nominal rate of vibration.

It occurred to us that this machine, on account of its rapid alternation of current, would be a good one to demonstrate Dr. Otto A. Moses's experiment of demagnetising a bit of steel brought within its influence, as described by him at the Pittsburgh Convention, N. E. L. A. We took our knife and rubbing the blade upon the pole-piece of the exciter for a moment it became a strong magnet and was able to pick up an iron nail with ease, then by placing it for an instant between the pole-piece and armature of the little alternating machine it at once lost every trace of magnetism, as was shown by its inability to attract the steel balance wheel of a watch, floated upon water. This we did a number of times, magnetising and demagnetising the knife blade at will. It has always been a matter of wonder to us, however, how Dr. Moses could have got near enough to the field of force of an alternating machine to demagnetise a steel magnet in his pocket. We do not doubt the fact, for he assures us that it is so, but we have often wondered just where he could have been, for we have often tried to demagnetise a steel magnet by holding it *near* an alternating current machine, and have always failed to do so, though by placing it between a pole of the machine and the armature it will lose it magnetism, as described in the above experiment.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending August 17th, 1888, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,813.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the week ending August 10th amounted to £4,914. The receipts for the week ending August 17th amounted to £4,596.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th August are £2,533, as compared with £2,048 in the corresponding period of 1887.

NEW PATENTS—1888.

11529. "Improvements in electric lighting." W. Towle and W. E. Langdon. Dated August 10.

11568. "Improvements in electric batteries." W. Shedlock. Dated August 10.

11569. "Improvements in secondary and other electric batteries." H. Pieper. Dated August 10.

11570. "Improvements in electric arc lamps." H. Pieper. Dated August 10.

11573. "Improvements in electric lamps." H. Head and L. Saunderson. Dated August 10.

11582. "Improvements in apparatus for the electro-deposition of metals and for the separation of chemical compounds or bases therefrom." F. H. Varley. Dated August 11.

11681. "Improvements relating to electric batteries and to exciting liquids or compounds therefor." E. Liebert and S. A. Rosenthal. Dated August 13. (*Complete.*)

11703. "Improvements in electric dynamos and motors." E. Crowe. Dated August 14.

11705. "Improvements in apparatus for measuring electric currents, and recording the amount of electric energy consumed in a given circuit." W. P. Thompson. (Communicated by the Westinghouse Electric Company, United States.) Dated August 14. (*Complete.*)

11718. "An induction apparatus—a substitute for dynamo-electric machinery—for the generation of electricity, without converting the energy of mechanical motion into the energy of electric currents, *i.e.*, without moving coils of wire past magnets or magnets past coils of wire." J. Gozo. Dated August 14.

11737. "Improvements in electric bell pushes." G. Binswanger. Dated August 14.

11749. "Improvements in the manufacture of carbons for electric lamps." J. S. Sellon. Dated August 15.

11766. "An improved electro-ozone producing apparatus. F. James. Dated August 15.

11782. "Means for disengaging the regulating mechanism of electric arc lamps and clockworks which disengage by electricity." E. Correns. Dated August 15.

11798. "Improvements in fittings for electric bells." W. Woodall. Dated August 16.

11809. "Improvements in electrometers and apparatus for measuring the electric potential of the earth and of its atmosphere, and of any other body or gas." A. H. Maurice, L. Carr and D. Owen. Dated August 16.

11817. "Improvements in electric furnaces." J. C. Hobbs. Dated August 16. (*Complete.*)

11858. "Improvements in electric batteries." O. C. D. Ross. Dated August 16.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1886.

8419. "Improvements in the means and apparatus for making needle speaking telegraph instruments semi-acoustic." E. Dunn. Dated June 26. 8d. Consists of two boxes of wood, upon one, or both, sides of which is fixed a small plate or stud of ivory. Upon the needle, as usually made and used hitherto, is soldered, or otherwise fastened, a short pin or bar, in such a position that it will strike endwise upon the aforesaid small plate or stud of ivory. The claims are 3 in number.

1887.

1337. "Improvements in galvanic cells." N. W. Perry. Dated January 27. 8d. Relates chiefly to the use of porous carbon as one electrode in the battery. The claims are 12 in number.

1531. "Electric lighting apparatus for locomotive engines." H. L. Pyle. Dated February 1. 11d. Relates to improvements in electric lighting apparatus for locomotive engines, one portion thereof relating to an electric arc lamp of the "focussing" type, which is placed in a large lantern carried in front of the engine, and to modifications thereof. The remaining portion of the said invention relating to mechanism for pivotally supporting the lantern and causing it to be automatically moved and adjusted to throw the beam of light across the cord of the circle as the engine begins to turn a curve, so that the track will be illuminated in front of the train even on the sharpest curves. The claims are 8 in number.

1571. "Improvements in methods of operating electric brakes for railways." E. E. Ries. Dated February 1. 8d. The object of the present invention is to arrange so that the brakes may be gradually applied and their power held under complete and perfect control. The claims are 12 in number.

2721. "Improvements in electric batteries." C. G. Curtis, F. B. Crocker, and S. S. Wheeler. Dated February 22. 8d. The object of the improvements, which are applicable to electric batteries generally, but are especially applicable to electric batteries required to give very strong currents and requiring comparatively frequent renewals, is to enable the battery to be taken care of and renewed with the least amount of trouble, to increase the power or amount of current obtainable from, and especially to reduce the internal resistance of the battery, and to provide means for conveniently raising the electrodes clear of the battery vessels or jars, and also for varying the amount of immersion and setting them at any desired depth by means of a handle or other convenient device, so that the power or current supplied by the battery can be easily and nicely regulated; and to enable this to be done in such a way that when the hand is removed from the handle the electrodes will remain fixed immersed to that extent. The claims are 15 in number.

3428. "An improved portable electric warning or signalling arrangement for platelayers and permanent way purposes." T. F. Remer. Dated March 7. 8d. Consists in the utilisation of a compact portable electric cell battery and vibratory signalling arrangement, which can be easily carried, and which is fixed between the six feet way or between the space dividing the up and down lines of a railway, for instance, where the platelayers are at work on the line or during the period of a fog. At a distance of 500 yards, or thereabouts, on the up and down line, is fixed a portable contact rod connected to the cell battery before-mentioned by the ordinary light electric conducting wires. The claims are 3 in number.

4533. "Improvements in electric locomotives and vehicles." M. R. Ward. Dated March 26. 8d. Comprises improvements connected with the switches by which the electric current is put into or out of circuit with various parts as required, improvements in the mechanism for steering the vehicles and for working a bogie when such is used, a guard for the belt or connection that transmits the motion to the driving wheel, a compound interlocking switch, and a combined starting, stopping, speed graduating, and steering device. The claims are 8 in number.

7185. "Improvements in electro-propulsive motors and in the application thereof to wheeled vehicles or rolling stock." W. H. Akester. Dated May 17. 8d. Claims:—1. The construction of electro-propulsive motors with side plates (having lugs or projecting pieces) by means of which the acting parts of the motor are coupled together and carried so as to be readily adapted to vehicles, substantially as described. 2. The improvements in the field magnets of electro-propulsive machinery, consisting of the washer or ring, coils, and pole-piece, the whole being constructed and arranged substantially as described and shown in the drawings.

9264. "Improvements in electric clocks." J. G. Lorrain. Dated June 29. 8d. Consists of improvements or modifications in the details of the form of chronoscope mentioned in the inventor's letters patent No. 8,181, dated 21st June, 1886. The claims are 9 in number.

10199. "Improvements in electric-metallurgical processes and apparatus therefor." H. C. Bull and Company, Limited, and H. Clay Bull. Dated July 21. 11d. Plumbago crucibles of suitable size are arranged in a suitable furnace or furnaces; preferably one fired by gas and of the regenerative type. The crucibles are made to form the anodes, and plumbago rods of suitable size are made to form the cathodes, and each crucible is provided with a porcelain lid. This crucible is filled with common salt, or chloride of potassium, which is brought to and maintained in a liquid state by the heat of a furnace, such as the one above specified. Hanging down from the porcelain lid is a ring made preferably of carbon, the same as the crucible, or when it is intended that the aluminium produced shall be alloyed with copper, copper may be substituted; and in this case copper cathodes may be used. When the aluminium is intended to be alloyed with any other metal whose melting point is sufficiently high to enable it to be used—such as iron, nickel, irridium, or platinum—the ring and cathodes may be made of these metals. The claims are 13 in number.

10555. "Improvements in electrical batteries." C. P. Elieson. Dated July 29. 8d. Claims:—1. In an electric secondary battery, the combination of two hollow electrodes, each of which comprises a series of layers of metal separated by alternating pieces or strips of asbestos or other suitable porous material, clamped or secured together by any desirable means, substantially as described. 2. In an electric primary battery the combination of a hollow electrode placed within a second hollow electrode, one of the electrodes being built up of a series of strips of material suitable for a positive electrode, and the other hollow electrode being built up of a series of strips of material suitable for a negative electrode, the adjacent strips being separated by distance pieces, substantially as described. 3. An improved electric secondary battery constructed and arranged, substantially as hereinbefore described and illustrated in the drawing. 4. An improved electric primary battery, constructed substantially as described.

10767. "Improvements in instruments for measuring electric currents and for regulating and controlling dynamo-electric machines and prime movers" W. Lowrie, C. J. Hall, and H. W. Kolle. Dated August 5. 11d. The inventors use a wire suspended between two rigid supports and apply to it, midway between the supports, a weight or spring of such power as to compel the wire, when heated by the current, to form an obtuse angle. The wire on either side of the weight or spring may be considered as a radius of a circle having one of the supports as a fixed centre, and any variation in length of the wire allows the weight or spring to move the apex of the angle to the point where two circles struck from the fixed centres with the altered radii would intersect. The claims are 6 in number.

11091. "Improvements in and connected with friction couplings governed by electricity." J. S. Raworth, and H. M. Sayers. Dated August 13. 8d. The simplest form of coupling constructed according to the invention, consists of a cone or disc on one shaft, and a hollow cone or a disc on the other shaft or on the pulley. The cone or one of the discs is provided with grooves in which are wound electric conductors through which a current of electricity may be sent in such direction as to produce rings or zones of alternate polarity. These poles attract the adjacent disc or hollow cone into forcible contact, thereby forming closed magnetic circuits. The adhesion between the surfaces causes the driving shaft to carry the driven shaft or pulley along with it at the same speed. The claims are 4 in number.

11704. "An improvement in electrical insulators." W. E. Langdon, J. C. Fuller, and G. Fuller. Dated August 29. 8d. Relates to the insulators described in the number of the Review for to-day. The claims are 2 in number.

11718. "Improvements in actuating mechanism for electrostatic generators." H. Glaeser. Dated August 29. 8d. Consists essentially in the use of two hollow drums as electric generators, the smaller drum being arranged within the larger one, and both rotating on a common axle, but in opposite directions. There is 1 claim.

11751. "Improvements in electrical signalling apparatus for railways." A. E. Nicholl. Dated August 30. 8d. The object of this invention is to provide an improved method of and apparatus for electrical automatic block signalling whereby the driver of a locomotive may be immediately informed when another train or locomotive is within a certain distance either before or behind him, and it will also enable the drivers of different locomotives to communicate with each other or with stations, pointsman's box, or other buildings when they are in electrical connection. The claims are 5 in number.

11776. "New or improved system or apparatus for synchronising electric telegraph instruments." W. H. Beck. (Communicated from abroad by G. A. Cassagnes, of Paris.) Dated August 30. 11d. Claims:—1. The combination of an electro tuning fork governing the speed of an electro-motor, phonic wheel, &c., and through it, of a brush rotating on a distributor at one station, and of two tuning forks with fixed rates of vibration, vibrating the one quicker and the other slower than that of the first station, and governing each one in its turn, and according as may be required, the speed of a second electro-motor, phonic wheel, &c., and consequently the speed of a second brush rotating on a second distributor placed at another station so as to keep the two brushes in synchronism; the two stations being connected by a single line wire, as hereinbefore described, and illustrated in the drawings. 2. The combination of three tuning forks placed at two distant stations, but each provided, on the same prong, with external and internal contact pieces, by means of which it is possible to make use, for the motion of the motors at both stations, of alternating current motors so as to produce a state of synchronism between the brushes rotating on the distributors placed at these two stations and connected by a single line wire as described and illustrated in the drawings.

11853. "Flexible supports for telegraph or other wires." F. Caws. Dated September 1. 8d. The inventor attaches the wires to movable or sliding or oscillating supports which are made self-adjusting longitudinally by means of springs, levers, weights, or other equivalent device, employed singly or in combination, and which are thus regulated to prevent any undue strain on the wire; the supports are also made capable of transverse action by means of pendulums, levers, springs, or other equivalent device, employed singly or in combination, which thus prevent the oscillation of the wires from producing chafing. The claims are 5 in number.

11932. "Improved means for making and insulating the joints or connections of electrical conducting cables." C. D. Abel. (Communicated from abroad by the firm of Siemens and Halske, of Berlin.) Dated September 2. 11d. Relates more particularly to establishing and insulating connections of electrical conducting cables having a central conductor insulated from an annular conductor or ring of conductors surrounding the same, whether such connections are for uniting two or more lengths of such cables with each other, or for establishing branch conductors thereon. The claims are 8 in number.

11950. "Improvements in electrical telephones." J. S. Ross and H. Baines. Dated September 3. 4d. Claims:—1. In a telephonic instrument the combination of a diaphragm with sheet or sheets, tissue or tissues of India-rubber or of gutta-percha. 2. In a telephonic instrument the use of the diaphragm or magnet or magnets in any way for automatically informing when a telephone requires adjustment.

14270. "Improvements in means or apparatus to be employed in the production of sheet copper by electro-deposition." B. J. B. Mills. (A communication from abroad by E. Emerson of America.)

Dated October 20. 8d. Claims:—1. In an apparatus for forming sheet metal by electro-deposition, the combination of the vat, the smooth cylindrical cathode having a surface to which the deposit will not adhere mounted in the vat, and mechanism for rotating said cathode during the deposition. 2. The combination of the cylindrical rotating cathode and the partitions holding the same, said partitions being removable with the cathode from the bath. 3. In an apparatus for forming sheet metal, the combination of the vat and the cylindrical rotating cathode therein, the said cathode having a surface to which the deposit will not adhere.

16554. "A new or improved electric apparatus for indicating distant water level and similar purposes." G. Binter. Dated December 1. 8d. Claims:—1. The combination of the metal drum with contact disc lever and pendulum. 2. The rollers in combination with the contact screw levers, drum, and disc, rollers journalled in movable insulated bearings and adapted to be pressed by springs on to the drum. 3. The combination with said devices of the pin wheel with the contact-breaking disc and spring. 4. The combination with said devices of stop levers and stop stars coresponding thereto, a sleeve carrying said stars together with discs, and spring having nose.

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100. "Improvements in and relating to apparatus for generating electricity." H. H. Lake. (Communicated from abroad by W. Humans, of America.) Dated January 3. 11d. Relates to magneto-electric apparatus for transmitting currents for ringing bells and like purposes. The claims are 9 in number.

112. "Improvements in incandescence lamp holders and switches." H. F. Joel. Dated January 4. 6d. Consists of an improved holder for incandescence lamps, with a switch to turn the light "on" or "off," a safety fuse, and a support for a reflector, shade, or glass globe, all combined in one, or alternatively a simple holder or combination of any of the parts with the holder to make a convenient and universal fitting for incandescence lamps. The claims are 7 in number.

4274. "Improvements in or relating to storage batteries." W. P. Thompson. (A communication from abroad by C. D. P. Gibson, of New York.) Dated March 20. 6d. Claims:—1. A shell, cell, or capsule, filled with the oxydised active material of a storage battery plate. 2. A shell, cell, or capsule, filled with the oxydisable active material of a storage battery plate. 3. A storage battery plate, having openings or perforations into which shells or capsules filled with active material are inserted and secured.

4275. "Improvements in or relating to storage batteries." W. P. Thompson. (A communication from abroad by C. D. P. Gibson, of New York.) Dated March 20. 8d. Claims:—1. A storage battery plate, having openings or perforations in which active material is placed and secured within the body of said plate, while left so as to be open to contact with the electrolyte. substantially as set forth. 2. The method of forming storage battery plates, which consists in making openings into said plates, thereby forming cells or receptacles having raised lips, rings or edges, filling the openings with active material, and securing said material therein by pressure or other means upon the said lips, rings or edges, whereby the openings are partially closed. 3. A storage battery plate, the active material of which is placed within cells or openings formed in said plate, and partly covered by portions of the metallic body of the plate, whereby the active material is held in place, and also is kept in contact with the electrolyte.

6204. "Improvements in induction coils and transformers." W. J. Muller. Dated April 28. 8d. The inventor takes a coil of the usual type, and outside the secondary coil thereof he winds another primary coil, outside of which he lays—parallel with the core—a series of iron wires, forming a second core outside the second primary coil. The claims are 2 in number.

CORRESPONDENCE.

Galvanic Belt Quackery.

It is with great pleasure that I have read your recent articles exposing the "Electropathic Quackery," and I thought you might be pleased to know that you have already done a good work, for a friend of mine in this town, Redhill (whose wife *fancied* one of these appliances *might do her good*), having read your article on the subject thinks very differently as to the *use* of these "Faith Healers," and he, together with myself, heartily thank you for making public the useless trash that is being sold.

W. G. R. Cooke.

August 18*th*, 1888.

I fail to follow Mr. Jerritt's insinuations contained in his last letter to you. I have asserted that on no occasion have I ever recommended a bogus belt, and in view of this definite assertion it is not my intention to trouble you again with correspondence. For Mr. Jerritt's information (although it is difficult to see what the ammoniaphone has to do with bogus belts), I may add that the notice given in *Health* on Mr. Lant Carpenter's report of the medical battery belt was written years before the ammoniaphone was heard of by me. I certainly became a director of the Ammoniaphone Company, but resigned within a week or two of my appointment, simply because I found I could not devote the necessary time to the affairs of the company. When next Mr. Jerritt attempts to draw my name into his controversies, I trust he will proceed not on assumptions and insinuations, but on facts. Here I leave the matter finally.

Andrew Wilson.

August 21*st*, 1888.

Armature Winding.

Will you submit the enclosed for the consideration of your readers?

In winding a ring armature of high potential with a quantity current of 10 ampères, and where space on periphery is limited, may 17 B.W.G. be considered of sufficient area to carry the quantity.

I would also submit whether the *calculated* resistance of a ring armature may be accepted as practical.

Thanking you in advance,

Cycloid.

August 16*th*, 1888.

Electrical Workman's Club.

Replying to Mr. Raison's letter in last week's issue, I am rather reluctant to have to admit that my failing is only one of Nature's many freaks, and had I been less acquainted with him I should not have taken any notice of his first letter. I would have given it a passing glance and thought, "Poor fellow, he suffers with the same complaint as myself; he is to be pitied, as I know that it is not his own fault." But when a man in full possession of his faculties suggests that electrical wiremen can be obtained for 20s. per week I think there must be something radically wrong somewhere. According to his theory any man is suitable providing he is working under a practical foreman. I must admit that he is correct in that respect; but can he find a foreman that knows his work who is willing to teach *raw* hands? This is one of the difficulties the E. W. Club intends getting over, and with the assistance of employers it can be done, and thus protect established firms from being troubled with *little* men who are running up installations at a price that no firm would do at twice, and in many cases three times, the figure. Employers know as well as I can tell them that this kind of business is going on at the present time, and unless it is at once stopped it will indirectly damage the reputation of their firms. The club, as I am given to understand, not only admits wiremen but every branch of electrical workmen; should carpenters be admitted, I strongly advise wiremen to turn their minds to another branch of business. Regarding Mr. Raison's gentle hint upon reputation—where are our learned men who allow this state of affairs to exist? Influence predominating over science and art, over many learned men whose names deserve to be written in letters of gold and handed down to posterity as of the great and good: "Surely they are not all dead." Employers will find that by assisting working men to amalgamate it will be to their advantage as well as that of the working man.

Trusting you will accept my humble apology for again trespassing upon your valuable space,

W. Howard.